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DAILY EDITION

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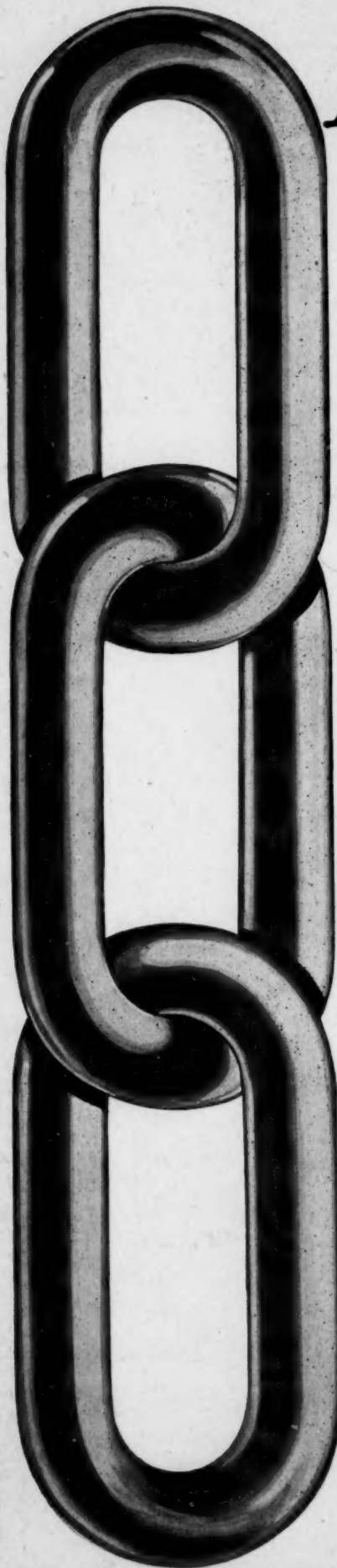
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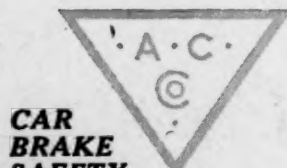
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WE GUARANTEE that of this issue, 15,000 copies were printed; that of these 15,000 copies, 13,480 were mailed to regular paid subscribers to the Railway Age and the Railway Mechanical Engineer; 140 were mailed to advertisers, 280 were provided for counter and news companies' sales, new subscriptions, bound volumes, samples, copies lost in the mail and office use; and 1,100 copies for distribution at Atlantic City.

THE RAILWAY AGE is a member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.).

The discussion of the report of the Committee on Electric Headlights again emphasized the need for an improvement in the manner of handling electrical subjects. The discussion dealt with sizes of lamps for switch engines, types of lamps, lamp voltages and back-up lamps, and expressed a need for more concrete data concerning the standardization of certain parts of all headlight equipment. It was very brief, however, and the attitude of most of those who took part in the discussion was that they did not wish to take up the time of a large number of men among whom there were relatively few who took an active interest in the design of headlight equipment. Means should be provided whereby the electrical men would have a better opportunity to give such subjects all the attention they deserve.

Discussion of Electrical Subjects

What do you expect of a feedwater heater? Twenty per cent increase in efficiency, perhaps. But wouldn't you be satisfied with even 10 per cent? Judging from the discussion following the report on feedwater heaters presented at the convention Friday morning, railroad men are satisfied with the results of feedwater heating on the Continent; Germany is not too poor to do a little experi-

What Do You Expect?

menting with this device and apply a few hundred heaters at a time. Does any one imagine that the full benefit of a feedwater heater can be derived without an effort to adjust the device to the locomotive or the locomotive to the device? Some mechanical men would like the full grown device, but they don't want to raise the baby. The following is a statement that was made in the discussion on this subject at the convention with reference to a single application of a feedwater heater on an American railroad: "We did not think there was a great deal of advantage to it (*the feedwater heater*), although it did show about 14 per cent saving in fuel." Wouldn't there be some advantage in saving 14 per cent of the fuel burned on American railroads at the current prices for locomotive fuel?

When one stops to think of how much more promptly European roads have adopted various economical features in locomotive design than have the railways of the United States, we begin to wonder if the reputation of America for efficiency is not exaggerated. A few years ago it was the matter of superheaters. Some of the European roads made a standard practice of superheating before the subject was hardly considered in the United States and now history is repeating itself in the case of feed water heating. There are thousands of locomotive feed water heaters in use on the railways in Europe where there is one in use on the railways of the United States. The first argument in defense of the American railway man will be that the cost of fuel has risen to a far greater extent in Europe than in the United States. This, of course, is true and is responsible at the present time for the rapidly increasing use of feed water heaters abroad, but the argument does not stand, as European roads began to apply feed water heaters on a large scale some seven or eight years ago, and in 1912, when coal prices were normal, there were over 3,000 feed water heaters in operation. Feed water heaters abroad have become as common on some railways as superheating is to-day in the United States. This method of fuel economy has great possibilities. Its efficiency has been established beyond doubt in Europe. There is no reason why it should not be in the United States.

Is America Slow in Modernizing?

There may be no question as to whether the railroads as a whole want university trained men. There is, however, a real question as to whether college men really want employment on the railroads. Almost every college man who has ever worked for a railroad has had his "experience." This has sometimes worked out very well, and it would be unfair to say that on many railroads he will not find support that will enable him to make good by dint of tact and perseverance. But it would be evading the fact to deny that there are still a very large number of railroad officials who find a sort of grim satisfaction in "smoking out" the college man. What the university graduate knows, or soon learns on most railroads, is that he must keep his identity as such "under his hat," that he must turn his diploma to the wall if he wants to get along. The college man is not wanted, however, simply because he is a graduate, but because he has a trained mind and has initiative. If you had to pick out to-day the man who would succeed you as superintendent of motive power 10 or 15 years from now would

The End of The Rope

1733

he be a college man? If the railroads permit the National Agreement to keep special apprentices out of their shops and persist in policies and prejudices that discourage rather than encourage college men, how long will it be before they will get to the end of the rope? Recent comment would indicate that so far as available material for many responsible positions is concerned, George Basford's prophesy, made before the Master Mechanics' Association 15 years ago, has already come true on more than one railroad.

One point was brought out forcefully in the discussion of Mr. Basford's paper. The policy of the roads with regard to motive power and shop equipment is too often dictated by expediency. The course to be followed is not carefully thought out in advance in all its ramifications and

More Engines Versus More Shops

not infrequently roads buy additional locomotives when shops or terminals are needed instead. Instances could be cited of roads owning more than 1,000 locomotives that have not a single shop equipped with cranes for un-wheeling heavy power. There are terminals in northern states where 30 or 40 engines are turned every day, but no facilities are provided for housing locomotives, except when they require heavy repairs. Is it surprising that some roads find the percentage of unserviceable locomotives increasing when the demand for power is greatest? Mechanical and executive officers should not lose sight of the fact brought out by Mr. McManamy that failure to provide adequate motive power destroys the only commodity the railroads sell—transportation. How many times have appropriations for shop or terminal improvements been stricken from the budget because the saving in the cost of repairs would not pay the fixed charges on the investment involved, neglecting entirely the economies that result from keeping the power in service a greater per cent of the time. Mr. Basford's paper should lead to a more thorough study by the roads of their requirements in locomotives, shops and terminals. If it puts an end to the hit-or-miss policy now in vogue, it will mark an impotent advance in the handling of motive power problems.

When the full possibilities of automatic machines in the rapid production of duplicate parts are first realized there

Limitations of Automatic Machines

is always a danger that the economical limitations of the machines will be forgotten. For example, a 1¼-in. by 7-in. guide bolt with a round flat head possibly two inches in diameter, can be made quickly and cheaply on an automatic, but there is a certain waste of material in turning the body of the bolt down from the original diameter. This bolt could be formed roughly in a forging machine by upsetting the end of a round bar of stock slightly over 1¼ in. in diameter. The later machine operations would consist of cleaning up the bolt (very little metal being removed) and cutting the thread. It is probable that in this particular case the bolt can be made most cheaply on an automatic, but, as the diameter of the desired bolt head increases in proportion to the body, there will be a point beyond which the value of the waste metal, time and power will more than offset the cost of first running the bolts through a forging machine. This is not to be

considered an argument against using automatic machines, but simply a reminder that automatics are not a panacea for all ills. Increased production at a smaller cost per piece is the goal of shop executives just now and in deciding which method shall be used in so simple an operation as making a bolt, it is important that no factors be left out of the consideration. Accurate records of power, labor and material costs must be kept in order to solve the problem correctly. In addition the shop executives and foremen must visit neighboring shops, read what others are doing and be continually on the alert for new and improved processes.

Few motive power department officers have not been cognizant in a more or less hazy way of the plain truths

Convictions Without Reason or Courage

so forcefully stated to them by George M. Basford yesterday morning. They all believe in the modernization of power. They would all like to have modern repair shops and engine terminals. Why don't they get them? There are two reasons—lack of facts and lack of courage. The usual excuse that the money is not available is not convincing. The history of railroad development in this country is replete with instances where vast expenditures have been made for the improvement of grades and reduction of mileage. But, during this same history, how many instances can be recalled where shops and maintenance facilities have been extensively modernized? Why has it been possible to secure appropriations for improvements of the one kind and not for the other? First, because the program for permanent way expenditures have been accompanied by a convincing array of facts as to the big returns to be obtained on the investment from reduced operating costs and increased traffic capacity. Second, because these facts have been presented with a persistence and courage which would not take "no" for an answer. Too frequently requests for appropriations in the mechanical department are supported by nothing better than personal opinions. Unfortunately, detailed records of shop and equipment operating costs are not available to furnish the facts that would get the money for proposed improvement programs. With nothing but opinions on which to base a campaign for extensive capital expenditure there is not much to inspire a courageous fight. The conclusion is obvious. Take measure to record detailed facts of equipment operating and maintenance costs, not forgetting any of the items which make up overhead. Then learn to use them intelligently. With such weapons no doubt need be felt that the motive power department will have the courage to win the fight.

It is a mistake to consider that the modernized engine terminal or any other one feature is the *most* needed

A Proper Balance

improvement on American railroads; but modern engine terminals are no less needed than any other feature and the important point is that a proper balance be observed between all developments in the mechanical equipment of the railroad. The purchase of Mountain type locomotives to handle suburban locals would be obviously absurd, yet the purchase of large Mallet locomotives for divisions on which there is not a single modernized engine terminal or even a turntable on which these engines can be turned,

as has occurred on more than one occasion, is just as inconsistent. In outlining the program for annual expenditures and in presenting the requirements of the mechanical department to executive officers, mechanical men cannot be too vigorous in their plea for improved engine terminals, nor too emphatic in their protests against the purchase of large locomotives for which the engine handling facilities are inadequate. The maintenance of a proper balance between all working parts is essential to an effective, smooth running organization, and there is no better evidence of efficiency than a consistent balance between all working parts. A very large passenger engine is out of place on a small local train and is wasteful because the locomotive does not have the opportunity to utilize its potential power. But it is just as inconsistent to have a large modern locomotive standing at a dilapidated terminal, waiting its turn at the restricted ash pit, or the single water spout and the one coal chute, only to be placed in a roundhouse with no facilities for washing the boiler with hot water or for giving prompt attention to all of the many devices that should be kept in good repair. Modernized engine terminals are indispensable to modern locomotives. A proper balance between all working parts is essential.

In periods of power shortage considerable attention has always been given to reducing the percentage of total locomotive hours spent in the terminal in order to meet the insistent demands of the operating department for power. In freight service the usual expedient has been to pool the locomotives. Immediate improvement during the emergency has usually been the result. This fact has led to the conclusion that the practice was justified as a permanent policy. Usually adequate records of locomotive performance were lacking either to corroborate or disprove this belief. Where actual facts are available, however, they do not justify it. In one case a comparative study of the cost of maintenance and the amount of traffic handled by the same group of locomotives for seven months of pooled service, followed by the same period of assigned service, showed a decided improvement from both standpoints while the engines were assigned. The cost of maintenance was about 30 per cent less for these engines during the assigned period and they made 18 per cent more mileage. The increase in ton-mileage was even greater because the train load was increased during the assigned period. The immediate advantage obtained by a change from assigned to pooled service is soon lost and in the long run the time lost owing to engine failures and the accumulation of neglected repairs leads to a reduction in the average proportion of running hours to total hours over that obtained from assigned locomotives. At the present time freight power is very generally in pooled service all over the country. Recent Railroad Administration statistics show that locomotives on the average are spending approximately 60 per cent of their time in engine terminals. This does not indicate any improvement over the conditions five or six years ago, before pooling became general, when N. D. Ballantine made the study of the distribution of locomotive time referred to by Mr. Basford in his paper yesterday. It seems evident that more tonage can be moved with less engines by restoring the practice of assigning locomotives. Under present conditions the engine terminal is the controlling factor and its capacity is still further decreased by the bad condition of the power which follows the practice of pooling.

Assigned Locomotives and Engine Mileage

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Program for To-day

The entire day has been set aside by Mechanical Section III to view the exhibits.

ENTERTAINMENT

10.30 A. M.—Orchestral Concert, Entrance Hall, Million Dollar Pier.

3.30 P. M.—Orchestral Concert and Impromptu Dancing, Entrance Hall, Million Dollar Pier.

9.00 P. M.—Musical, Entrance Hall, Million Dollar Pier.

Program for Sunday, June 13, 1920

3.30 P. M.—Sacred Concert in the Music Rooms of the Marlborough-Blenheim. The Albert Taylor Orchestra, New York City.

Lost and Found

FOUND—In a rolling chair, a black fur neck scarf. Apply to Secretary Conway's office.

LOST—Badge 6923. Return to Secretary Conway's office.

Registration Figures Grow Larger

THE FOLLOWING ARE THE comparative figures of registration up to noon yesterday, when Book No. 3 was sent to press:

	1919	1920
Members, Section III, Mechanical.....	458	666
Special guests	563	285
Railroad Ladies	601	413
Supply Ladies	350	649
Supply Men	1,900	1,935
Purchases and Stores .....	....	37
Total	3,872	3,985

These figures are not strictly comparable for the two years because the Car Builders met first last year.

Apropos of Movies

MR. FULLER (on the floor of the convention Friday morning): Do I understand the invitation from the Purchases and Store Section is to review pictures of a supply train?

Chairman Tollerton: Yes.

Mr. Fuller: I wonder if we could not get them to produce pictures of supplies. Supplies seem to be more important to-day than trains.

R. S. M. A. Election To-day

THE ANNUAL MEETING of the Railway Supply Manufacturers' Association will be held in Convention Hall at 12 o'clock noon to-day.

The Nominating Committee announced yesterday the following choices for officers of the Association for the coming year:

President—J. F. Schurch, vice-president, T. H. Symington Company, Chicago.

Vice-President—Charles D. Jenks, president, Damascus Brake Beam Company, Cleveland.

The members of the Nominating Committee were: Samuel G. Allen (Chairman), P. J. Mitchell, A. L. Humphrey, J. Will Johnson, A. C. Ashton, Harry W. Frost, Scott H. Blewitt.

Registration For Cornell Banquet

A GOODLY NUMBER of Cornell graduates have signified their intention of attending the annual banquet, which will be held in the club room of the Traymore at seven o'clock on Saturday evening. Those who have not already registered should leave their names with A. F. Stuebing at the *Railway Age* booth before noon to-day.

Manufacturers on the Railroad Question

STEPHEN C. MASON, of the McConway & Torley Company, who is attending the conventions, is president of the National Association of Manufacturers, which is the principal organization of manufacturers in this country, or in the world, for that matter. Most of the railway supply companies are members of the association, but its membership is representative of all branches of manufacturing in this country.

At its annual meeting which recently was held in New York the National Association of Manufacturers adopted a preamble and resolutions entitled "Platform for American Industry." Among other things the resolutions set forth that "It is not the function of our government to own or operate industry, but to protect and encourage its legitimate development under private ownership and management. It should therefore abstain from competition with its own citizens in any form of business which they can successfully undertake.

"The regulation of free enterprise is justified by necessity, when for the common good. But the form it assumes is vindicated only by the practical test of its effectiveness to accomplish its avowed purpose. Thirty years of drastic business restriction through the Sherman Act, demonstrates that competition should not be compelled where regulated co-operation more beneficially promotes the public interest."

Upon the subject of transportation the resolution said:

"We approve the return of the railroads to their owners who are the investing public, and favor their private ownership and operation under government regulation.

"The present condition of our railways is deplorable. They lack the funds and credit to provide the facilities and equipment for handling the present national business or to make the additions and extensions necessary to meet the constant development of production. To save the business of the country from irreparable injury, railroad rates must be speedily readjusted upon a basis which will re-establish and maintain railway credit and capacity to render adequate service.

"A shortage of transportation limits every form of production and trade and impedes all social progress. The controlling principle of public railroad administration should, therefore, be the promotion and development of a carrying service fully adequate for national needs.

"We favor the permissive consolidation of existing railway systems under such conditions as will promote economies of operation, efficiency in management, and maintain competitive rivalry in service.

"We favor the development of a definite and constructive plan of national transportation, inter-relating railroads, waterways and hard surfaced roads.

"Every available means should be employed to promote better understanding and closer co-operation between the public and the railroads. The deliberate obstruction or interruption of transportation service is intolerable. Railroad strikes inevitably become lock-outs of the farmer and factory worker and boycotts of the public."

Railway Club Secretaries Meet

THE SOCIETY OF RAILWAY CLUB SECRETARIES held its annual meeting yesterday morning at the Blenheim. W. E. Cade, Jr., of Boston, vice-chairman, presided in the absence of the chairman, A. J. Merrill, of Atlanta, secretary of the Southern and Southwestern Railway Club, who is convalescing from a severe attack of the "flu."

This meeting was preceded on Thursday by a round-table luncheon at the same hotel. The guests of the society on that occasion included Daniel M. Brady, of New York, founder of the organization; H. C. Manchester, president, New York Railroad Club; D. W. Pye, treasurer, New York Railroad Club, and chairman of the finance committee of the Central Railway Club; J. E. Fairbanks, general secretary and treasurer of the American Railroad Association; Roy V. Wright, chairman, committee on subjects, New York Railroad Club; W. H. Winterrowd, president, Canadian Railway Club of Montreal, and G. M. Wilson, superintendent motive power, Grand Trunk, Montreal, and a member of the auditing committee of the Canadian Railway Club.

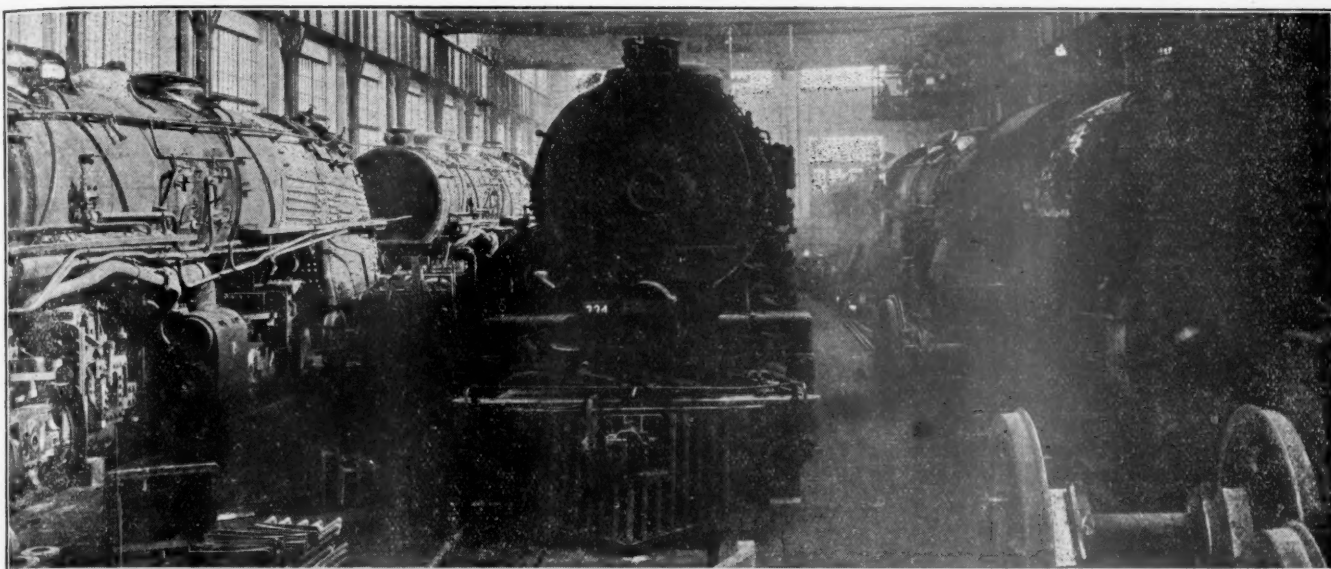
Probably the most important action during the extended session was an agreement designed to broaden the scope and usefulness of the society which is expected to lead to the organization of a new association whose membership will be limited to secretaries of railroad associations. This is dependent on the idea appealing to the secretaries, to whom it will be submitted. In that event, the secretary and treasurer is to prepare the necessary amendment to the present Constitution and By-laws of the society to conform to the action taken on this occasion, the intention being to later, probably in the Fall, hold a meeting of all interested. The careful consideration given to the plan contemplated resulted in the conclusion that such an association of secretaries will be conducive not only to the benefit of members, but will ultimately be advantageous to organizations they represent.

The secretary was instructed to convey to J. E. Fairbanks an expression of appreciation of the thoughtfulness which led to the big innovation which he has had made in connection with the annual meetings of Section III—Mechanical, in providing a place and facilities for the handling of the correspondence, etc., of members or their representatives.

An understanding was reached which is expected to result in making more complete each month the announcement of papers and their authors before each of the railway clubs, the object being to afford railway club members accurate and the earliest information possible as to these matters. As usual, at the end of the club season, the society will compile a complete Index of Papers and Authors that have had the attention of the various clubs during the preceding nine months—this to be published with an abstract of the minutes of the annual meeting of the society in the September issue of the proceedings of each club.

The secretaries devoted much time to an exchange of suggestions, methods and practices as a result of which they were able to give each other some new ideas calculated to promote increased efficiency and the concrete and prompt handling of club affairs with which they are entrusted under the direction and supervision of members of their respective executive committees.

Officers were elected for the ensuing year as follows: Chairman, W. E. Cade, Jr., New England Railway Club, Boston; Vice-Chairman, W. A. Booth, Canadian Railway Club, Montreal; Secretary-Treasurer, Harry D. Vought, New York Railroad Club and Central Railway Club.

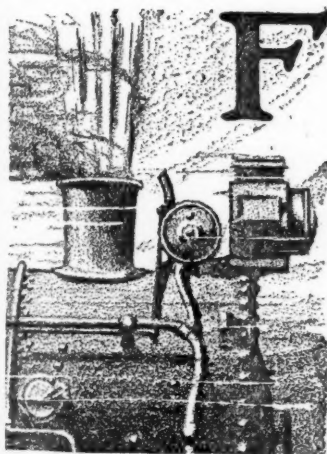


American Railroad Association—Section III—Mechanical

George Basford's Paper Leads to Spirited Discussion on Vital Needs of the Motive Power Department

Chairman Tollerton called the meeting to order on Friday morning at 9:40 o'clock.

Locomotive Headlights and Classification Lamps



FOLLOWING the progress report submitted at the 1919 convention, the committee has kept in touch with the progress and practices of the various railroads during the past year. There appears to be a desirability for uniformity in practices as to capacity of generator, type of steam driving unit, details of connections and wearing parts of both generator and steam unit, sizes of lamp, reflector, etc.

The incandescent headlight lamp has now been practically made standard on the railroads in this country.

With such a lamp for that particular use on both road and switch engines, together with a generally uniform practice as to the size of lamps in cabs, markers, and classification signals, it is practical to indicate a somewhat close specification for the generator and steam driving unit. Taking into account the necessity of being able to transfer on short notice the equipment from one engine to any other engine, it is believed that such an equipment should be of 500-watt capacity, of the turbine driven type, and should be capable of developing 32 volts and full load at a steam gage pressure of 100 lb. The governor should also regulate the speed of turbine properly under a range of steam pressure between 100 lb. minimum and 250 lb. maximum.

There are many details of the generator and turbine that experience in handling somewhat similar equipments indicates should have uniformity in certain dimensions and arrangement on the equipments as furnished by the several manufacturers. This is, of course, for the express purpose of obtaining prompt

interchangeability in service and reduction in the stock of renewal parts. It will be apparent that the bolt spacing of the base should be the same on all equipment, also that the size of steam pipe should be the same. It would be advantageous if the location of the steam exhaust and drain connections were identical on all turbo-generators. As to the renewal parts, the ball bearings can be made similar, brushes can all be the same size and all bolt and screw threads should be standard.

In locating the turbo-generator on the engine, four details must be considered. In the first place, short steam pipes are necessary. Long pipes are difficult to maintain and increase radiation losses. The location must be one that is accessible for inspection without interfering with the inspection and care of other parts that require both inspection and renewal. It must not interfere with the vision of the engine crew and the exhaust steam cannot be permitted to cloud up the front cab windows, condense over the cab roof, or in any way become a nuisance to the crew. It is desirable, therefore, and seems to be the general practice, to have the generator set placed near the cab. Many roads are placing it longitudinally with the boiler and on the left-hand side where the wire conduit to the headlight is placed. The generator end is usually set toward the cab to avoid the collecting of snow and ice or water inside the generator, and commutator case. This position has a further advantage of being within reach of a man standing on the running board, as well as being away from the condensation and moisture from the whistle and safety valve discharge.

There is a strong preference for the use of metal conduit in wiring cabs. For outside wiring, this is the general practice. When used in the cab, the conduit placed on the ceiling and on the sides should not be rigidly connected. All drops should be made through suitable fittings so that in ordinary maintenance or the overcoming of trouble on the road no joints in the wires will have to be disconnected.

The use of a 250-watt, G-30, 32-volt concentrated filament lamp for headlights of road engines and of a 15-watt, S-17, 33-volt special cab lamp for all lights in cabs, classification sig-

nals, markers, etc., is practically standard everywhere. For switch engine headlights there is still considerable difference of opinion as to what size lamp can be used and meet both the requirements as to the 300-foot vision and the frequent objections of yard crews to a light that is too dazzling. The National Lamp Association have under consideration a series of road tests to determine the vision range of headlight lamps of different capacities. They have requested that the committee be represented and this invitation has been accepted. The committee has suggested that the scope of the investigation include lamps of various capacities combined with reflectors of different sizes and constructions, to determine the size of lamp with type and size of reflector required to meet definite vision requirements.

Since the 1919 convention, under instructions, marker lights and other lights on rear of tender, as well as classification lights on the engine, are being wired for electric lamps. This requires a considerable change in the arrangements on most roads and the plans being followed vary considerably. A large number of the members have furnished the committee with blueprints and it is hoped that these plans can be reviewed critically and from them a recommendation made for presentation at the Convention.

There is a growing demand for a headlight reflector that will not require such constant attention to keep clean as is necessary to give the usual silvered copper reflector. Several types of reflectors are being developed along this line and it is expected that after the lamp tests are made some definite information will be available for the members.

Recommendations

Your committee would recommend the following for submitting to letter ballot as Recommended Practice:

1. For electric headlight equipment, incandescent lamps be used with a 500-watt turbo-generator capable of developing 32 volts and full load at a steam gage pressure of 100 lb., the governor to regulate the speed of turbine properly between steam pressure range of 100 lb. minimum and 250 lb. maximum without the necessity for change of nozzle or governor parts.
2. The turbo-generator should be located as near the cab as practicable, preferably set longitudinally with the boiler, on the left hand side, with generator end toward the locomotive cab and in a position so as not to obstruct the vision of the fireman. Where conditions will not permit location of turbo-generator in this manner, it should be placed on the top of boiler with dynamo end toward side equipped with the conduit system (preferably the left side).
3. The use of a 250-watt, G-30, 32-volt concentrated filament lamp in headlights of road engines.
4. The use of a 15-watt, S-17 33-volt special cab lamp in cabs, signal or engine number lights and all other outlets, other than the headlight lamp.
5. The use of a dimmer in connection with road engines' headlights, so wired that the engineer can reduce the intensity of the light as desired and in accord with the rules.
6. That all wiring in cabs be in metal conduits so applied that it may be removed intact, a loose connection being arranged between the conduit placed on the ceiling and on the sides of the cab.
7. All drops should be made through suitable fittings placed on the ceiling of cab where possible, in back of and not directly over the boiler so that they are readily accessible.

The committee requested approval of the plan to work jointly with the manufacturers of headlight turbo-generators, and the Association of Railway Electrical Engineers in developing standard practices as to: (a) Bolt spacing of the base; (b) size of steam, exhaust and drain pipes; (c) location of steam, exhaust and drain pipe connections; (d) size of ball bearing; (e) size of commutator brushes, and (f) bolt and screw threads.

The report was signed by H. T. Bentley (Chairman), Chicago & North Western; C. H. Rae, Louisville & Nashville; W. H. Flynn, Michigan Central; W. O. Moody, Illinois Central; A. R. Ayers, New York, Chicago & St. Louis; H. M. Curry, Northern Pacific; A. G. Williams, Pennsylvania System, and J. L. Minick, Pennsylvania System.

Discussion

In introducing this report the Chairman stated that the life of headlight casings is very short, due to corrosion, and that he was glad to note that the manufacturers are at last getting out a cast iron casing, which will result in greatly increasing the life of this part of the equipment.

He added that the practices of the railroads in the selection of a generator equipment and type of lamp for electric head-

lights, and in installing them, are very similar. The usual variations are in minor and unimportant details. Therefore, for uniformity, it is recommended that (a) the generator be of 500-watt capacity, 32-volt and turbine driven; (b) the generator be located preferably near the cab, on the left side of the locomotive and longitudinal therewith; (c) a 250-watt G-30 32-volt incandescent lamp be used in the headlight of road engines; (d) a 15-watt S-17 33-volt lamp to be used for all other lights on all engines (this refers to cab lights and not switch engine lights); (e) a dimmer be used with the headlights of road engines; (f) wiring in cabs be in metallic conduit; (g) drops be made through fittings.

It was also suggested that certain standard practices be developed for base bolt spacing, steam and exhaust connections, size of ball bearings, brushes and bolt and screw threads.

Chairman Tollerton: We have in the hall this morning representatives of the Association of Railway Electrical Engineers that assisted in the preparation of this report. They have been granted the privilege of the floor, and I would be very glad to hear from some of them on the discussion of the merits of the paper.

J. L. Minick (Pennsylvania): There is one point that I might call attention to. The Association of Railway Electrical Engineers and the American Railroad Association have both recommended the use of 33-volt, instead of 34-volt, cab lamps. That is due very largely to the fact that a great many electrical headlight equipments are used for furnishing current for the lighting of suburban trains, and the train lighting service generally throughout this country is the 33-volt. With the 34-volt cab lamp, 33-volt train lamp, and 32-volt house lighting service, all of which use the same lamp, it throws a great deal of confusion into the manufacturing of lamps, and the manufacturers are agreeable, so far as we have been able to ascertain, to standardizing everything at 33 volts.

It is questionable as to just what headlight lamps should be used in switching service. The rule issued some months ago by the Railroad Administration indicated that the 100-watt lamp was desirable. Some railroads seem to believe that a 60-watt lamp was desirable, while still others have a little more faith in a 25-watt lamp, due to the fact that with the smaller lamp you get probably a little diminution of light, but do not get the glare that you necessarily must have if you use a larger lamp.

It remains, however, for the future to show just what we should or should not use, and I expect the tests mentioned by the chairman of the committee to bring forth some real concrete data along that line.

The suggestion has been made as to the use of glass reflectors, not only in yard service, but in road service. There is some objection to the use of glass reflectors on account of the cost. The larger sizes which appear within some limited needs will be rather expensive, and it is questionable whether that expense is justified.

R. J. Needham (G. T.): We would like to know something about what has been done in the United States in regard to the back-up lamp in road service. There seems to be some necessity with the engine backing down to the yard to have a back-up lamp.

H. T. Bentley (C. & N. W.): During Railroad Administration control instructions were issued that such a lamp be provided, and a large number of roads are now going ahead with that program. I do not think there is anything compulsory about it, but to comply with the A. R. A. train rules it is necessary to have such a lamp, and the C. & N. W. is putting on the small size lamps.

C. E. Fuller (U. P.): There are several lamps being manufactured at the present time and presented to the railroads a good deal upon the same plan as the marker light. Some are riveted on the rear of the tender, and others put in a socket, showing both red and white lens, the red lens to be used in backing down into the train yard and the white lens in case the engine is backed up on the road. Some of the railroads are using the marker light in conjunction with this feature by wiring the tenders.

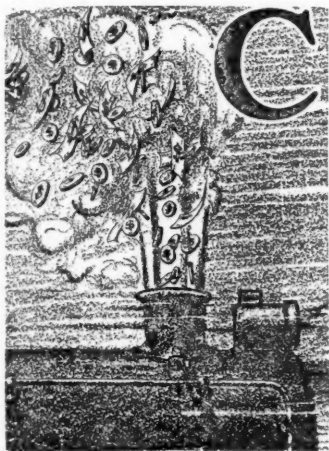
As far as I can ascertain, most of the roads, if they are using this light at all, are departing from the use of the oil lamp and going to the use of the electric light. It is not compulsory, and in a great many yards it is a question whether the light is really necessary, but in large terminals, such as the New York Central

terminal in New York City, the Erie terminal, and the Chicago terminals, where they are running in conjunction with traffic, a light is necessary.

It was moved that the recommendation of the committee be submitted to letter ballot as recommended practice, and that the

report be accepted and printed in the proceedings, and that the committee be instructed to work jointly with the manufacturers of the headlight Turbo-generators, and the A. R. E. E. in developing certain standards indicated. This motion was seconded and carried.

Report on Feed-Water Heaters for Locomotives



CONDITIONS NOW APPEAR to be favorable for a renewal of interest in feed-water heaters for locomotives, and while trials have been somewhat retarded by the unusual conditions of the past few years, we appear to be on the eve of an extensive application of heaters, under more favorable conditions than at any previous time, on account of the high cost of fuel and the greater need for its conservation.

The members of the association have before them the very valuable individual paper by Mr. J. Snowden Bell, Associate Member. (See

1917-1918 proceedings.) The author's conclusion is that a feed-water heater "can and will be developed and adopted with the most substantial benefit in locomotive operation."

The author of this paper classifies feed-water heaters as of two different types, which may be termed, respectively, as (a) surface or closed heaters and (b) injection or open heaters, at the same time mentioning the fact that type (a) in which the heat transfer to the feed-water is effected through walls of comparatively thin metal, has been the more frequently experimented with and, for several reasons, has heretofore seemed to be the more practical and desirable of the two types.

While this opinion has no doubt been more or less generally held, the latest developments suggest that the open heater, which operates under practically atmospheric pressure, has no small tubes as heating surface and delivers the heated feed water and condensed exhaust under suction to the boiler feed pump, using an oil separator, has fully as good, if not a better chance of final success, considering the conditions which should obtain in an efficient heater.

For the present heaters using waste gases from the flues are not considered, but only the exhaust steam as the heating medium; because (a) these two sources of heat are independent of each other and require separate heaters, and where both of them are employed in conjunction, the exhaust steam must or should be used first, although usually in tandem with the other, and (b) the exhaust steam carries much the larger portion of the waste heat (approximately six times that in the waste gases), and this heat is more readily available. With the open heater especially, it has been much more successfully employed than that of the waste gases, without interference with the working of the locomotive.

The committee began its work by endeavoring to accumulate information by means of a letter of inquiry addressed to the members, and replies were received from 86 railroads. Seven roads report that they now have, or very recently have had, feed-water heaters in service and give full replies to the circular. Four roads state that they contemplate the use of heaters. The remainder of the replies are to the effect that seventy-six roads have had no recent experience in the use of feed-water heating appliances.

A tabulation of the replies, which were made in full, describing feed-water heating systems in use at present, or but recently removed from service, is given in Appendix I (not included). Appendix II gives data on open and closed heaters tested by the Pennsylvania Railroad. Appendices III, IV and V give comments of the Baltimore & Ohio, Boston & Albany and Canadian Pacific, respectively, on their experience with feed-water heaters.

It appears from this survey that at the present time there are

in use in this country but two general types of feed-water heaters, the closed heater having a number of small tubes and the open heater in which the exhaust steam is condensed by a jet of cold feed-water. Attempts at heating the feed-water while in the tender tank have been made by using the air compressor exhaust for this purpose. The arrangements were not entirely successful or satisfactory on account of the difficulty in pumping the heated water to the boiler. When the temperature of the water was low enough to be handled by an injector the saving was very small.

It has been suggested that water having a high percentage of incrusting solids would make feed heating impossible, on account of the scale deposited on the tubes of the heater. Such water would, no doubt, be troublesome if used in a closed type heater. The open type heater, however, could be expected to handle such water with no more difficulty than when injectors are used.

The location of the heater apparatus on the locomotive is of considerable importance. The exhaust steam should have short and direct passages into the heater; and heater, pumps and piping should be placed so as to be easily drained. The attachment of the heater and pumps to the side of the boiler has been found of advantage in the prevention of freezing.

It has been found that the superheat of the steam is reduced when the feed heater is used, and a new basis should be established for determining the necessary superheating surface for feed-heater locomotives. An enlargement of the superheater should be considered for new construction only, the reduction in superheat not being sufficient to require a revision of existing superheaters when feed-water heaters are applied to old locomotives.

It appears from present indications that feed-water heating for locomotives is about to be given a thorough trial on a few roads and, with the improved heaters now available, the committee believes that a satisfactory arrangement of heater can be developed and that the members should assist by installing heaters on their roads in order that data may be obtained under as many different operating conditions as possible.

The report was signed by F. M. Waring (Chairman), Pennsylvania; Wm. Schlafge, Erie; A. Kearney, Norfolk & Western, and W. H. Sample, Grand Trunk.

Appendix II—Pennsylvania Heater Tests

An open-type heater of the Worthington design was applied to a Mikado-type locomotive on the Pennsylvania Railroad in October, 1918, and three others in the early part of 1919. All are still in service and have given no serious trouble, although experience with them has shown where minor improvements can be made. They have been found thoroughly practicable, even when the heater locomotives are handled by enginemen who have had no previous experience with them.

Open-Type Heater Tests

The first of these heater locomotives was operated on the Altoona testing plant before it was used in road service. A number of changes and adjustments were made in the heater, during the early test runs, of which there were nineteen. When satisfactory working of the heater had been established seven additional tests were made, without change in the heater, and a summary of the results of these is given in Tables I to IV.

Because of the decreased draft when steam is taken from the exhaust pipes for feed heating, the exhaust nozzle was reduced from a diameter of 7 in. to 6¾ in. for these tests. This change was found necessary to obtain high evaporation, but even with the smaller nozzle the draft, in the directly comparative tests,

averaged considerably less than without the heater. It was sufficient to develop a satisfactory maximum power.

As would be expected, the decreased combustion rate resulted in a lower degree of superheat when the heater was in use. This decrease was between 30 and 40 deg.

COAL CONSUMPTION

The evaporation of 52,475 lb. per hour, and the indicated horsepower of 2,650, which were obtained with the heater, are far beyond the usual operating requirements for these locomotives.

TABLE I—WATER CONSUMPTION DURING THE OPEN-HEATER TESTS

Test No.	Test designation	Length of test, hrs.	Feed water from tank, lb. per hr.	Feed water at heater inlet	Feed water at heater outlet	Temperature, rise in heater, deg. F.	Water lost from heater, lb. per hr.	Steam condensed and added to feed water	Feed water to boiler, lb. per hr.
1	2	3	4	5	6	7	8	9	10
5,000.109	60-20-F	2.0	12,746	41	178	137	2	1,735	14,480
5,000.108	80-30-F	2.0	16,828	40	190	150	3	2,538	19,364
5,000.106	80-50-F	2.0	25,958	39	202	163	8	4,285	30,238
5,000.110	120-50-F	1.0	31,439	39	208	169	18	5,398	36,820
5,000.111	120-50-F	1.0	31,237	40	209	169	28	5,383	36,594
5,000.105	120-60-F	1.0	39,905	39	208	169	92	6,819	46,640
5,000.107	160-60-F	0.5	45,072	40	211	171	354	7,722	52,474

TABLE II—EXHAUST STEAM CONDENSED AND STEAM CONSUMPTION OF THE OPEN-HEATER PUMP

Test No.	Test designation	Temperature at heater, deg. F.	Exhaust steam			Steam used by feed pump			
			Pressure at heater, lb. per sq. in.	Condensed and added to feed, lb.	Condensed, per cent of total feed	Lb. per hr.	Lb. per double stroke	Per cent of feed	Speed of pump, double strokes per min.
1	2	3	4	5	6	7	8	9	10
5,000.109	60-20-F	214	1.4	1,735	12.0	384	0.38	2.7	17
5,000.108	80-30-F	215	2.0	2,538	13.1	446	0.35	2.3	21
5,000.106	80-50-F	230	3.2	4,285	14.2	630	0.32	2.1	33
5,000.110	120-50-F	238	6.0	5,298	14.7	747	0.30	2.0	41
5,000.111	120-50-F	230	6.0	5,383	14.7	747	0.30	2.0	42
5,000.105	120-60-F	270	6.4	6,819	14.6	875	0.31	1.9	47
5,000.107	160-60-F	277	9.9	7,722	14.7	912	0.29	1.7	52

TABLE III—HEAT RECOVERED BY THE OPEN-TYPE FEED-WATER HEATER

Test No.	Weight of steam, lb. per min., going to				Heat in steam, b. t. u. per min., going to				Heat recovered from exhaust steam by feed heater	
	Engines	Feed pump	Safety valve	Feed heater	Engines	Feed pump	Safety valve	Total	B. t. u. per min.	Percentage of total heat in steam
1	2	3	4	5	6	7	8	9	10	11
5,000.108	314.5	7.4	0.8	42.3	402,749	8,876	960	415,585	50,726	12.3
5,000.106	492.8	10.5	0.7	71.4	639,063	12,594	840	652,497	85,694	13.1
5,000.110	599.1	12.5	2.1	90.0	780,867	14,994	2,519	798,380	108,063	13.5
5,000.105	757.3	14.6	6.5	113.7	996,531	17,393	6,597	1,020,521	136,736	13.4

TABLE IV—COAL SAVED BY THE OPEN-TYPE FEED-WATER HEATER

Test No.		Test designation	Speed in M. P. H.	Indicated horsepower		Coal per I. H. P. Hr., lb.		Coal saving by feed heating, per cent
Without heater	With heater			Without heater	With heater	Without heater	With heater	
1	2	3	4	5	6	7	8	9
5,000.79	5,000.108	80-30-F	14.6	990	965	2.2	2.0	9.1
5,000.80	5,000.106	80-50-F	14.6	1,549	1,534	2.3	2.0	13.1
5,000.81	5,000.110	120-50-F	22.0	2,001	1,949	2.3	1.9	17.4
5,000.82	5,000.105	120-60-F	22.0	2,388	2,373	2.9	2.2	24.7

The work to be done by the boiler in evaporating water is reduced in proportion to the amount of heat recovered in the heater. The saving of coal should be and is, evidently, greater than this on account of the boiler being operated at more efficient rates with the heater than without. Also, it is evident that the saving by feed heating is greater when the locomotive is exerting its greatest effort. It is assisted most by the heater when assistance is most needed.

That there is a saving in coal by the feed heater is shown in Table IV. These economies were afterwards confirmed by road testing of heaters of this type.

STEAM USED BY BOILER FEED PUMP

The feed pump which it is necessary to use with the heater requires steam from the boiler and this steam is a direct charge against the heater, unless part of its heat can be recovered in the heater. In these tests, except No. 5000.111, the exhaust steam from the boiler feed pump was condensed and weighed. Table II shows the steam used by the feed pump at different rates of boiler feeding. This steam is between two and three per cent by weight of the total steam produced by the boiler at these rates of evaporation.

In Test No. 5000.111 the feed-pump exhaust steam was put into the main exhaust steam line going to the heater at a point in front of the oil separator, with no apparent effect on the temperature in the heater. This is about the result to be expected; the total weight of steam condensed in the heater is also about the same in the two cases. Therefore, when using the feed-pump exhaust, the main exhaust is called on for as much less steam as the feed pump supplies, thus, to some extent, reducing the necessity for making the exhaust nozzle smaller than that used without the heater. There should, therefore, be something gained by putting the pump exhaust into the heater, and in the heater arrangements used on the road the pump exhaust is used in the heater.

WEIGHT OF EXHAUST STEAM CONDENSED

With the open-type feed-water heater the exhaust steam used to heat the water is condensed and becomes a part of the boiler feed-water supply, and while it would be possible to weigh this condensation, this would be impracticable, as heat would be lost, and the regular action of the heater interfered with. Instead of weighing this condensation, its weight has been calculated from the observed temperature of the steam and water by means of the following formulæ:

$$S = \frac{W(h_1 - h_0)}{H - h_1} = \text{Exhaust steam condensed and added to feed water, lb. per hr.}$$

W = Weight of feed water from tank, lb. per hr. (deducting losses).
 h_0 = Heat in feed water from tank, B.t.u. per lb. (cold water).
 h_1 = Heat in feed water from heater, B.t.u. per lb. (hot water).
 H = Heat in exhaust steam, B.t.u. per lb. (at heater).

The weight of steam condensed as found by this method was added to the weight of feed from the tank and the total was the water fed to the boiler and evaporated.

OIL IN EXHAUST STEAM

One of the objections advanced against the use of the open heater is the possibility of cylinder oil being carried into the boiler and causing foaming and other trouble. The cylinder oil now used is a mineral oil with an added six or seven per cent of animal oil, in the form of lard oil or tallow. This animal oil is said to have acid-forming properties when in the boiler and to cause corrosion of the metal, but the principal danger seems to be the possibility of the mud or scale on the boiler and the oil uniting and forming a putty-like substance on the firebox and causing overheating of the sheets.

In tests at low rates of evaporation, the exhaust steam in the heater supply pipe appeared to be saturated and there was a dripping of oily water amounting to about 10 to 12 gallons per hour, from the oil separator. At high rates of working, the exhaust steam was superheated and there was no drip of water or oil from the separator. In the road service of these heaters no trouble from the oil has developed after a year and a half of use.

ROAD SERVICE TESTS

Following the tests and development work on one open heater on the testing plant, it and three others of the same general design were put into road service on Mikado-type freight locomotives. After they had been used some little time, a record of performance was made with two of these heater locomotives, using, first the heater and then the injector, during a round trip over a division about 100 miles long.

Six round trip results with heaters and four with injectors are averaged in Table V. The coal was measured by shovelfuls, and the water by levels in the tender tank which had been calibrated.

The weights of coal and water are assumed to be fairly accurate approximations and the basis for determining the saving was the evaporation per pound of coal. The average evaporation per pound of coal for both east and west bound trips, with the

TABLE V—TESTS OF THE OPEN-TYPE HEATER IN ROAD SERVICE

	Without heater		With heater	
	East-bound	West-bound	East-bound	West-bound
Time in motion, hours.....	7.72	7.84	8.92	7.88
Ton-miles per trip.....	576,892	171,703	650,947	182,349
Cut-off, per cent.....	53.3	41.4	50.6	44.2
Coal used, lb.....	20,260	16,947	18,631	18,006
Coal used, lb. per hour.....	2,625	2,162	2,089	2,286
Water used, lb., including steam condensed in heater.....	167,208	163,820	197,748	180,966
Water used, lb. per hour.....	21,659	20,895	22,169	22,966
Evaporation per lb. of coal....	8.4	9.7	10.6	10.1
Feed-water temperature in tender tank.....	51	50	49.0	51
Feed-water temperature from heater.....	.....	.....	198	191
Feed-water temperature rise....	.....	.....	149	140

heater, was 10.3 lb. and with the injectors, 9 lb., thus showing an increase in evaporation per pound of coal of 14.4 per cent.

There appears to be no reason to expect any decrease in the heating effect after long service of the heater and check temperature observations recently made on these heater locomotives show

TABLE VI—WATER HEATED, TEMPERATURE RISE AND STEAM CONDENSED WITH THE CLOSED TYPE HEATER

180 Brass Tubes $\frac{5}{8}$ in. Outside Diameter, 46 in. Long, Heating Surface 113 sq. ft.

Test No.	Test designation	Length of test hours	Feed water temperature		Temperature rise in heater, deg. F.	Water pressure loss in heater, lb. per sq. in.	Lb. per hr.	Steam condensed in heater
			At heater inlet	At heater outlet				
5,067	80-30-F	2	21,011	55	207	152	6.9	3,308
5,070	80-50-F	2	31,457	53	207	154	9.4	4,850
5,069	120-50-F	1	37,947	54	207	153	13.4	6,095
5,068	120-60-F	0.75	46,797	53	210	157	16.2	7,854
5,071	160-65-F	0.50	56,510	51	212	161	16.5	8,492

192 Brass Tubes $\frac{5}{8}$ in. Outside Diameter, 46 in. Long, Heating Surface 121 sq. ft.

5,000.18	80-30-F	2	19,160	53	209	156	.....	3,210
5,000.19	80-50-F	1.5	29,077	52	212	160	.....	4,948
5,000.20	120-50-F	0.75	36,824	48	213	165	.....	5,742
5,000.26	120-60-F	1	46,900	52	219	167	.....	7,690
5,000.21	160-65-F	0.75	60,709	49	219	170	.....	9,748

TABLE VII—COAL SAVED BY THE CLOSED-TYPE HEATER Heating Surface 113 sq. ft.

Test No.	Test designation	Speed in m. p. h.	Indicated horsepower		Coal per I. H. P., hr., lb.		Coal saving by feed heating, per cent
			Without heater	With heater	Without heater	With heater	
5,005	5,067	80-30-F	15	876.3	2.24	1.87	16.5
5,001	5,070	80-50-F	15	1,536.4	2.33	2.03	12.9
5,002	5,069	120-50-F	22	1,963.2	2.54	2.03	20.0
5,003	5,068	120-60-F	22	2,382.3	2.84	2.25	20.8
Heating Surface 121 sq. ft.							
5,005	5,000.18	80-30-F	15	876.3	2.24	2.19	2.2
5,001	5,000.19	80-50-F	15	1,536.4	2.33	2.02	13.3
5,002	5,000.20	120-50-F	22	1,963.2	2.54	2.03	20.1
5,003	5,000.26	120-60-F	22	2,382.3	2.84	2.16	23.9

that the feed-water is still being heated to temperatures well above 200 deg. with a temperature rise of 160 dg. or more.

Tests of Closed Heaters

Much attention has been devoted to the development of the surface or closed heater on the Altoona test plant and the final arrangement of heater of this type has a high efficiency in heat transmission. This heater consisted of groups of small brass tubes, making up the water passages, and each tube contained a

brass strip crimped and twisted to cause heat absorption by thorough agitation and mixing of the cold and heated water. The tubes were surrounded by a casing which received the exhaust steam. The feed-water was passed four times through the heater by means of divided headers and separate tube groups.

Typical test results with closed heaters are given in Tables VI and VII. These tests were made on the same Mikado-type locomotive that was used for the open-heater tests.

In tests with the closed heaters the condensed exhaust steam was not recovered, but we understand the latest design makes provision for returning this condensation to the tender tank.

Appendix III—Caille Heater on the Baltimore & Ohio

The Baltimore & Ohio Railroad contribute in substance the following:

In 1913 a Mikado (2-8-2) type saturated steam locomotive was equipped with a feed-water heater of the Caille design, a heater of French make, of the closed type and using exhaust steam drawn from the exhaust base in the smokebox.

The heater was not satisfactory for examination, cleaning or overhauling and was abandoned on account of faulty design which led to frequent failures and expensive maintenance; the apparatus not being properly designed for power of this large capacity.

There was considerable trouble in maintaining the many parts of the heater. The tubes were very light and would not remain tight in the tube sheets for any length of time. The pipe joints loosened from the water hammer of the pump and constant leakage was experienced. In the hot-water cylinder the cast-steel piston was covered with composition which in a short time would flake off and cause pump slip. Brass rings were substituted but did not prove satisfactory. The pump was of insufficient capacity to feed the boiler when working hard and the injector had to be used as an auxiliary at regular intervals.

Appendix IV—Experience of the Boston & Albany

The experience of this road with the heater during a period of six months led to the following comments and conclusions:

When the feed-water heater is used there is a slight loss due to comparatively low thermal efficiency of boiler-feed pump as compared with the thermal efficiency of the injector.

The cost of maintenance of feed pump will evidently be more than the cost of maintaining the injector. The cost of maintaining piping, valves, etc., used in conjunction with the heater will evidently be more than the cost of maintaining the injector piping.

When the locomotive is in operation the average number of strokes of boiler-feed pump is approximately 52 per minute; and at this rate the feed-pump uses approximately 665 lb. of steam per hour, according to information furnished us.

There is a loss of heat in drips from the heater which are not utilized on locomotive 561.

There is no evidence that the use of the heater instead of the injector increases the hauling power of the locomotive. Locomotive 561 can be operated in a satisfactory manner by the use of the injector, and with greater convenience to the engine-men.

The temperature of feed-water leaving the heater when the throttle is open varies from 210 deg. to 220 deg., exclusive of abnormal fluctuations. When drifting or when the locomotive is not running, the temperature of feed-water usually drops to less than 100 deg. and the effect of closing the throttle is immediately reflected in reduced temperature of feed-water. There is less danger of cretin boiler strains due to cold water by the use of the injector than there is with the heater. We consider this particularly important.

If the exhaust from the boiler-feed pump were connected into the heater the temperatures of the feed-water entering the boiler when the locomotive is drifting would be somewhat higher.

The normal back pressure of locomotive 561 when using the injector may be considered as 6 or 7 lb., and under the same

working conditions the heater apparently reduces the back pressure by $2\frac{1}{2}$ lb.

As the feed-water temperature in the heater varies from approximately 230 deg. to 85 deg. there is a probability of developing leaks in the heater. It has been necessary to roll heater tubes a number of times to keep them tight.

We do not consider it good operation to use the heater when the engine is working steam and the injector when the engine is drifting. If, for any reason, it is necessary to discontinue the use of heater, there is no way of closing the valves without going to the front of the locomotive and this is objectionable.

The use of the heater practically prohibits the use of a top boiler check, account of the disastrous results which might be expected if cold feed-water is allowed to strike on boiler plates at a temperature of 387 deg. F.

Our experience with the heater indicates that the injector is more reliable than the feed-water heater so far as feeding the boiler is concerned. It is more convenient to operate the injector than it is the feed-water heater, and we find that the volume of water pumped by the feed pump varies according to the steam pressure in the boiler. When the boiler pressure drops it is necessary to increase the speed of the pump to keep the water at the proper level. This means that the engineer must give the pump more attention than is needed with the injector, and it is not desirable to distract the attention of the engineer from looking ahead for signals, etc.

The feed-water heater, when in good condition, successfully heats the feed-water to a temperature of between 210 deg. and 220 deg. F., when the throttle is open, by utilizing a certain percentage of the exhaust steam, but that the abstraction of this exhaust steam adversely affects the draft of the locomotive. The use of the feed-water heater on locomotive 561 does not effect a saving in fuel, as compared with the injector, but increases maintenance cost.

The Locomotive Feed Water Heater Company claims that the heater should save one per cent of coal for each 11 deg. added to the temperature of the feed-water, which, in the case of locomotive 561, would be about 14 per cent, and the claim is also made that this is accomplished by utilizing 15 or 16 per cent of the exhaust steam for use in the heater and that the use of this percentage of exhaust steam does not affect the draft of the locomotive.

So far as locomotive 561 is concerned, we have not found any saving in coal or water due to the use of the heater, and apparently it would be difficult to improve with this feed-water heater upon results now being obtained when operated with the injector.

Our experience leads us to believe that the heater will show up to better advantage on a level road than on a road having physical characteristics of the Boston & Albany, where considerable drifting is done, but evidently the heater is still in the development stage and further improvements must be made before it will give satisfactory service without excessive maintenance charges.

Appendix V—Experience of the Canadian Pacific

The Canadian Pacific states that experiments have been made for the past fifteen years with various types of waste-gas and exhaust-steam feed-water heaters. A great deal of information has been obtained, although practically the majority of arrangements throughout the past have proven unsuitable for one reason or another.

A feed-water heater is now being designed which is to be tried out thoroughly in competition with other feed-water heaters on the market. A considerable amount of experimental work is considered necessary before any satisfactory heater is discovered for climatic conditions on this road. A new design is being developed in which the heater is an integral part of the locomotive.

Discussion

In introducing this report the chairman said that the committee could make only a brief progress report, as it is not prepared to offer definite conclusions, due to the lack of heaters in service. He also stated that the committee heartily endorses the

opinion of J. Snowden Bell, given in his paper, read before the Association and appearing in the 1917-1918 proceedings.

Since this report was put in print, the committee has received some information as to the European practice, through the courtesy of Robert E. Thayer, European editor of the *Railway Age*, with regard to the use of feed water heaters on locomotives. According to this information there are over 10,000 locomotives equipped with feed water heaters in Germany alone, and the number is being added to at the rate of about 2,000 per year. The Knorr system is the standard and is being applied to both old and new locomotives.

In Switzerland there are up to the present 21 locomotives provided with Knorr feed-water heaters, and 11 others are shortly to be fitted up with them.

In Holland the Knorr system is used entirely. There are about 300 locomotives equipped out of a total of 1,000, and it is understood that their present program calls for the application of heaters to all of their principal types of locomotives.

In Belgium there are a number of locomotives which were furnished by the Germans under the terms of the armistice, a large number of these being fitted with the Knorr heaters. Ten of the consolidation locomotives which they have recently ordered from England will be fitted with the Weir heater, and five of the consolidation engines ordered from America will be fitted with the Worthington heater.

In France the Caille-Potonie system is used, and there are 145 of this type now in service, with 272 on order. It is also reported that there are 20 in service in Tunis, 8 in Belgium, 50 in Roumania and 3 in Turkey.

In England it appears that but little has been done recently, although there is a tendency to consider seriously the application of feed-water heaters to locomotives on account of the increase in cost of fuel. Out of 12 replies received, 5 railroads have none installed, one road has one, two roads have two, one has five, one has 53, and two have some heaters but the number was not stated.

W. H. Sample (G. T.): We have just got one heater installed. I expect that it is out on its first test to-day. We have tried out the Weir heater, but owing to difficulty in our cold climate with the pipe we did not think there was a great deal of advantage to it, although it did show about 14 per cent. saving in fuel.

H. T. Bentley (C. & N. W.): I would like to ask Mr. Sample what difficulty he had with the heater during cold weather. I understood that the machine was out of operation because of a freeze-up probably.

Mr. Sample: Our data in the office of the general superintendent of motive power showed that the connections to the heaters were always giving trouble, they were always leaking, and we could not keep them tight. In cold weather the heaters gave a great deal of trouble, and in fact it became a nuisance, and it was decided that there was not sufficient advantage owing to these difficulties, to perpetuate it at that time.

J. Snowden Bell: I do not think I can add anything to what was said in my individual paper, to which the chairman of the committee has referred. In the preparation of that paper I made a very exhaustive research of the practice, both in the United States and in Europe, and the result of my investigations was that I came to the conclusion, which I announced in very strong terms in that paper, in which I understand the present committee has concurred, that a feed-water heater would be a most valuable and economic addition to a locomotive. I saw no reason why, even in view of the failures which were reported, that a feed-water heater of proper design could not be provided. I think so now, and I do not think we can too strongly urge on the members the advisability of giving their best attention to the production of a feed-water heater of that kind.

The demonstrated economy cannot be denied, and with coal at the present price, I do not see how we can afford to neglect any appliance which will offer such an economy.

G. W. Rink (C. of N. J.): The Central Railroad of New Jersey has just placed in service a large Mikado engine equipped with one of these feed water heaters, but we are not in position to say now what results we expect to achieve. I believe, however, that the application of feed water heaters for large locomotives, is a step in the right direction. We certainly would not erect a large stationary power plant and neglect to install a heater and I think the same thing applies to large locomotives.

W. H. Sample (G. T.): I would like to say before the close

of the discussion that the committee did not think itself that there was sufficient interest taken in the subject, and the advantages which might be derived from the application from the heaters. The points in its favor were not brought out, which would have been shown had the right kind of interest been

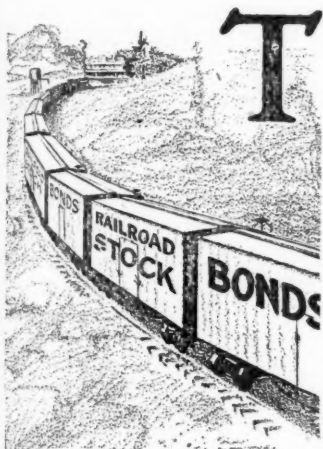
manifested in the development of the heater. I would urge all concerned to give us all the information they can and we will do the best we can with the subject in our report next year.

A motion that the report be received and printed in the records was seconded, and carried.

The Locomotive as an Investment

By George M. Basford

* President, Locomotive Feed Water Heater Company



THE LOCOMOTIVE IS A BIG INVESTMENT, and it must be so considered and so treated. In no other branch of engineering development has so much progress and improvement been made in efficiency as has been made in the steam locomotive during the present official generation, and the improvement has just begun. If all new and all existing locomotives are made as efficient as the best, and it is possible to make them nearly so, private ownership and operation of railroads will be put in the way of success. But, no matter how efficient the power unit may be as a

unit, its operation must be such as to obtain the benefit of the possible efficiency for the maximum number of ton miles per hour. More ton miles per hour is the only salvation of the railroads. Among other things, this calls for the best locomotives and the best use of locomotives, quick and continuous movements, reduction of idle hours, quick terminal movements, improved dispatching, improved maintenance and repair facilities and repair methods, also fuel and labor saving improvements of every possible kind. It calls for resourcefulness in keeping locomotive wheels turning most continuously and most effectively.

Steam Locomotive Here to Stay

Whatever we may have in the future, today the steam locomotive is the most vital influence in the progress of civilization. Its possibilities for assisting in meeting the problems of the present and future by reducing the cost of transportation lie beyond the imagination of all who have not made a careful study of the improvements now available for increasing capacity.

Whenever you wish you may put on the rails locomotives that, from a performance and particularly an efficiency standpoint, will hold their own with the best non-condensing power plants on land or afloat. You may at any time produce a draw-bar horsepower per hour for 2.25 lb. of coal at the speed giving the maximum power of the engine. The problem is how to make all the locomotives in this country approach the standard already set, how to make the best use of facilities that are already available, also how to keep abreast of further improvements.

Importance of Overhead

It has been stated that the value of locomotives used on our railroads is 60 per cent of the total value of all the machinery, implements and tools used in all of the other industries in the country. Is this equipment used as efficiently and as effectively, when it is used, as is that of our manufacturers? A manufacturer is mighty careful about his \$25,000 and his \$100,000 machines to keep them busy. If he does not, he goes "broke." He puts cranes over them. He keeps raw material coming and clears away the finished product. He keeps them in repair. He works them night and day by watching operation and methods. He treats them as a big investment and keeps them going. He thinks of his machinery as being worth so many dollars per hour and he knows just how many dollars in each case. That is why he makes money.

In increased production an important lesson is learned from the electric locomotive. It costs more than the steam locomotive, and its friends have seen to it that it is given every opportunity for greater continuity of service. Expensive machinery ties up lots of capital. That machinery must produce or the carrying charge is overwhelming. The true significance of the word "Overhead" needs to be emblazoned in the railroad dictionary. Everything possible to do that will keep the wheels moving must be done. "Overhead" is the nightmare of the business man and the manufacturer, and it ought to be of the railroad man. Railroad men do not worry about it as much as they ought. Production is the answer to overhead in manufacturing business and in railroading. How to make the locomotive pull more tons per ton of coal, per ton of its own weight, per dollar of wages, per hour of the day, per year, per dollar of shop, terminal and track investment, and per mile run, is the answer on the railroad.

Figures prepared to illustrate the increased cost of locomotives built two years ago, compared with the cost of exactly similar engines today were too painful to be included in this discussion. They reveal the fact that those built most recently are up against a serious handicap. They must earn several times more than their predecessors in order to make good. Not only has the cost of new engines gone up; the value of old ones from a capital standpoint has gone up and so also has the cost of maintenance and operation. Therefore, every locomotive must produce more—as much more as is physically possible.

Motive Power Chiefs Should Be Vice-Presidents

In order to secure increased production from locomotives a serious handicap must be overcome. Railroads are essentially machines. Transportation success depends very largely upon the character and the use of the power plants that move the tons. Not all the operating officers have come to their high places with sufficient knowledge and intimate contact with the locomotive to understand and thoroughly know what a locomotive should be and what it should be expected to do. It is not their fault, but it has been unfortunate for the railroads.

Many of the members of this organization know that for many years the speaker has implored the mechanical officers of American railroads to compel the locomotive problem to take its proper place in railroad organizations and therefore in railroad operation. For years the speaker has urged a more commanding position for the mechanical officer and the mechanical department. In the present crisis this means more than it ever did. As a matter of course, traffic, accounting, legal and sometimes purchasing responsibilities are given recognition and high standing by being administered by officers of the rank of vice-president. This is as it should be. In my opinion, the pulling power of the railroads can never be what it ought to be, and what it may be, until motive power problems are solved and motive power policies are presided over by officials acknowledged and supported by the standing that the officer in charge of locomotive design, construction, operation and maintenance requires, not to mention the other question of cars. This suggests that the mechanical policies of the railroads, using 26½ per cent of the fuel of the country, involving technical responsibility for upwards of six billion dollars' worth of property, for more than four hundred million dollars spent per year in locomotive repairs and presenting possibilities to effect savings upon the expenditure of over a billion dollars per year for fuel, might with profit be presided over and decided by officers of the standing of vice-presidents. This ought to happen, but it should be done in such a way as to accomplish three things: First, safeguard

mechanical policies; second, provide for maintenance and operation of mechanical matters through the operating department; and, third, provide prospects and official standing which will constitute adequate reward for lifelong effort in a line of endeavor that requires this incentive.

On the other hand, if our railroads do not take care of their mechanical officials they will continue to lose men whose knowledge, experience and ability are needed in order to prevent public ownership and operation. They must be given the opportunity to increase production of transportation, and, fortunately, they know how to help to do it. In many cases they are obliged to plead and argue for improvements with higher officers who do not always appreciate the importance of these mechanical questions. Sometimes the decision concerning equipment is in the hands of persons or departments whose responsibility does not extend to the operating results. Too often prices only determine their decisions. Such a selection of equipment is not only detrimental to the operating results, but most discouraging to the motive power officers who must keep the locomotives going and going at the minimum cost of fuel and repairs.

Profit, Not First Cost Important

The vital thing is to make a *profit* on transportation. Profit is not determined so much by the first cost of the piece of machinery as by the economy of its performance. Under certain conditions a costly machine may be far more profitable to its owner than a cheap one, which is wasteful in its workings. Railway executives have realized this point in electric locomotive installations. Such installations have not been hampered by traditions such as exist with the steam locomotive, and the engineers are allowed a free hand to produce the best possible economic results. It would be worth while for any railroad to give an order for steam locomotives to do certain work at minimum cost per unit of work done without restriction as to the cost of the machine. The speaker knows of no record of this having been done. He predicts surprising economies when it is done.

This constitutes the strongest argument for basing locomotive recommendations upon facts that can not be questioned and for pushing plans to conclusions. High officers will yield to the insistence of arguments the strength of which is made clear to them. Show the president the meaning of the locomotive as a big investment, and, in justice to himself and the road, he can not cut money-making improvements out of his appropriations. The president always defers to some authority in mechanical matters. It is most fortunate for every one concerned when this authority is his own mechanical organization. Unhappily it is not always so.

Bigger Boilers Possible

An example of subjects which open the way to revolutionary improvements in the locomotive is dynamic augment, which opens up great possibilities in increased capacity of locomotives. About six years ago a systematic movement to reduce reciprocating weights and decrease dynamic augment was started. It was carried on successfully up to the beginning of the war and then stopped. This work must be resumed. Railroad men were beginning to realize that it was not the static or dead weight of the locomotive alone that was important, but the dead weight plus the additional weight put on the rails by the unbalanced weights at speeds. When the dynamic increase from the unbalanced weights is reduced by lighter weights of reciprocating parts more weight may be put into the boiler. This development lies right at hand. It is well worked out and is ready for immediate application.

Let us see what this means. Consider what are known as the 2-10-2 "A" and "B" classes of Administration engines. They have not enough counterweight in their main wheels to balance the rotating weights at the main pins. With ordinary open hearth steel parts, as these engines are built, there is a lack of rotating balance at the main pins of 390 lb. This produces a dynamic augment at 54.2 miles per hour equal to 50 per cent of the static weight at the main wheel. By the use of high quality steel forgings for reciprocating and rotating parts it is possible to reduce this unbalanced weight in the main wheel to very nearly zero. This would also help the overbalance in the other wheels. Of course, it must be made clear that there was insufficient time to consider this in the Administration engines.

Furthermore, if the Administration heavy Mikado is given specially designed reciprocating and revolving parts of high quality steel its destructive action upon the track at a speed between 40 and 45 miles per hour will be less than that of the Administration light Mikado that is fitted with the present corresponding parts of open hearth steel. The advantage thus gained is cheap when it costs only a change in material and refinement of design. At all speeds at which these engines are at all likely to damage the track the heavy Mikado, if built with light reciprocating parts, will be actually a safer engine than the light Mikado is now. The heavy Mikado has 10 per cent more tractive effort, 14 per cent more heating surface and its total weight is 9½ per cent greater than the light Mikado.

The excellent report to this Association in 1915 on this subject should be followed by another study of this promising development which means so much to the track and to bridges, as well as to the locomotive itself. Maintenance of way officers are now studying stresses in track. They take dynamic augment into consideration but they seem to accept it as necessarily high instead of considering it is a series of forces which may by refinement be reduced. It may be greatly reduced. The reduction will relieve the track immensely, and relieve boiler restrictions.

Boiler Design Improved

About eight years ago methods of laying out sizes, capacities and proportions of locomotive boilers changed from the empirical to the exact. New rules were established. These were based on the power of the cylinders, and the boiler was designed to produce the necessary steam. This is not as simple as it sounds. The result of the change in methods was to put locomotive designing on a higher plane, equal to that of marine and stationary engine design. What this has meant to our railroads and what it means now, with increasing weight, size and power of locomotives, is difficult to estimate, but it is safe to say that we could not build the big engines of today on the basis of the rules of design recommended by this Association in 1897. The locomotive builders have introduced these radical improvements in elementary design. Others have insistently and consistently developed improvements of factors making for better use of fuel and of steam. The use of steam in the cylinders, production of superheated steam, the subjects of combustion, stokers, steam conservation and boiler circulation are now studied in locomotive practice as they have been studied for years in the stationary and the marine fields. Locomotive combustion is being studied as it never was before. This has revealed the relative value of firebox, combustion chamber and tube heating surface and has thrown new light on the subject of air supply to the fire, baffling and mixing the gases and the form and volume of fire boxes. In fact, the fire box has been transformed into a proper furnace. If stationary and marine engineers were limited as to size and weight as locomotive designers are limited, the progress that the locomotive has made during the past few years would be appreciated.

Fix Up Old Engines

There is scarcely an item that goes to make up an efficient and safe locomotive that has not been improved to make more power and more mileage. They not only make for better use of fuel, but they keep the engine from going to the shop as early and as often and they protect the crews. These improvements need not be mentioned in detail. They are well known, are past the experimental stage and are available to transform the fuel, wage, time and tonnage wasters into money makers because the improvements are applicable to old engines as well as to new ones.

Enginemen and firemen know these things. They know how modernizing transforms an engine. They understand what these factors mean to the big new power and they can not be expected to exert themselves to the utmost and give most efficient service when so many of them must work with engines that they know to be capable of so great improvement. Not the least of the advantages of modernizing is its effect upon the men. They naturally do better work when provided with good tools.

New engines are usually well equipped for good performance. They are usually provided with most of the factors that make for increased capacity and improved economy. Their application to old engines offers a wonderful opportunity for a big money saving improvement. This application to old engines is a

gold mine ready for immediate operation. These old engines may be made, weight for weight, as good and as efficient as new ones. How many men in this meeting realize the task before them if they were asked to explain to a successful manufacturer the reason why this has not been done? How often a twelve or fifteen car engine is seen on a four or five car train. This happens on roads having hundreds of engines that if modernized would handle light trains economically while the big ones do not. This is somewhat like turning piston rings in a wheel lathe. This is difficult for a manufacturer to understand, especially when it is so easy to bring small, old engines up to date.

What Has Happened to Some Engines

Turn to page 55 of the Proceedings of this Association for the year 1917 to see how a single modernizing factor changed the maximum power of an engine. By applying this improvement to a consolidation engine on the Big Four, the power of the engine at 27 miles per hour was increased one-third. The speed at which the engine produced its maximum power was stepped up 42 per cent. This is typical of the possibilities on other engines with correspondingly greater improvement when all the modernizing factors are applied.

Not long ago, one of the largest Pacific type passenger engines in the country gave up its train because of a loose tire. A twenty-year-old eight-wheeler took the train of eight steel cars forty miles into the terminal in time to save refunding the excess fares. The little eight-wheeler had been modernized. The engineer said: "The bosses don't know what these modernized little engines will do. They do not know what we have to work with, and they do not use the old engines as they should after they are modernized. The tendency is to overlook their possibilities." Due in part to this experience, thirty more of these small engines on this road are now being modernized as they go through the shops.

When one of our big railroads was considering the application of a fuel saving and capacity increasing factor for modernizing existing engines and improving old ones, the problem of keeping one of its important passenger trains on time was pressing. The regular train had six coaches and one parlor car and was hauled on a very fast schedule by a Pacific type saturated engine which usually was unable to make the schedule with nine cars. One of the engines was modernized in the hope that it would handle ten cars. In the first test the train had seven cars. On each of the following test runs one additional car was put on until the engine handled 15 cars on schedule time. Let me here make record of the fact that one of our great railroads declined even to try out this particular improvement until its owner agreed not only to furnish it without obligation on the part of the railroad, but to remove it at his own expense if it did not satisfy the representations made for it.

In another case modernizing saved 300 old eight-wheel engines which were too ineffective to be maintained as they were. They were good to haul wooden cars, but were outclassed by steel equipment. Approximately 30 per cent in fuel was saved by modernizing and they were made sufficiently powerful for steel car trains.

Modernizing received its first good start by the improvement of a lot of Mallets. Another road has rebuilt Prairie type engines into Mikados with 21 per cent increase in tractive effort. Another road changed over 300 Consolidations into Mikados. At speeds of 35 miles per hour the last mentioned rebuilt engines have a drawbar pull of 22,300 lb., whereas the Consolidation engines gave only 8,500 lb., at that speed. These were comprehensive changes which have proved successful. Modernizing usually need not be carried as far as to change the type or wheel arrangement. Its greatest field lies in adding improvements without this change. Every railroad man knows that he has this opportunity before him. It is unnecessary to cite further notable examples, although this paper could be filled with them. The thing to do is to get into action, survey all existing engines, plan the modernizing and rejuvenate a certain number of engines per month on a real time card as they go through the shops.

In 1915 a comparison was made between two engines. One was a Consolidation which represented best practice before the time modernizing of design and introducing of fuel saving factors began, the other was a Mikado built in 1915. The Mikado delivered 82 per cent more work for the same amount of coal,

which in each case was as much coal as the fireman could handle. The engines were designed for the same road and the same service and represented the advance of ten years in modernizing on the road in question, including design and the use of fuel saving, capacity increasing factors.

The locomotive of ten years ago, unmodernized, is very little more efficient than one of 70 years ago. Modernizing three of them, however, is usually equivalent to an additional engine of the same size. The rest of the problem is to get the utmost service out of the improved engine and to obtain on the road the increased capacity known to be available. The available improvements should be capitalized and made to earn money. Not only should the locomotive itself be considered as an investment, but the improvements should also be so considered.

Electric Locomotive Fallacy

Electric locomotive partisans are propagandists in arguments for electricity versus steam. They argue, however, on the basis of the steam locomotive as they knew it in the past rather than as it is today. They further weaken their case by absurd claims to the effect that electric locomotives can save two-thirds of the coal burned by all the steam locomotives in the country, and they base their claims on the steam locomotive of ten years ago. The truth is that in five years of this period the economy and the capacity of the steam locomotive has more than doubled. The object is not merely to win out against the electric, but to pit the steam locomotive against the high cost of everything. Constructive, systematic policy of locomotive engineering and operation is the way to do this and it will do it.

We Hear Too Little About This

We are told that electrics are replacing steam locomotives. We do not hear enough about the 38 steam Mikados that replaced 12 Moguls and 38 Consolidations on the Missouri, Kansas and Texas several years ago, and of the 41.8 per cent increase of train load, also of the reduction of 23 per cent in the number of trains. The Norfolk and Western replaced 57 engines with 40, with a reduction of 26 per cent in the number of trains for the same traffic. The Delaware and Hudson showed a saving of 43.8 per cent in coal by substituting Mallets for Consolidations. Each Mallet replaced two Consolidations. A year later each of these Mallets showed 7.6 per cent better fuel records and each of them continued to do the work of two Consolidations while burning less coal than one of the Consolidations. On the Chesapeake and Ohio 25 Mallets replaced 44 Consolidations, saving 37 per cent in the cost of handling freight traffic. This has been going on the country over in cases too numerous to mention, but too little is said about these improvements and too little is said about future possibilities. When every existing locomotive is thoroughly modernized and when all are operated with the study, care and supervision called for, and when coal and fuel oil are used as if they were expensive—then this Association and the men who make it will be recognized for saving the railroads. In this scheme of things the obsolete engine lacking labor saving, capacity increasing, fuel conserving and safety factors has no place.

For further development we have the tractive effort booster, also the fixing of cut-off to give maximum power at every speed of the engine to which B. B. Milner referred at this convention last year.

Scrap the Old Shops

Shops for quick and economical repairs to big engines present possibilities for revolutionary modernizing improvement. If the "average" railroad shop should be made the subject of investigation and report with a view of equipping it to put locomotives back on the road repaired as quickly and as cheaply as possible, it is the speaker's opinion that the honest recommendation of the investigator would be to salvage the old and build a new shop, from foundations up. Shops as well as locomotives need modernizing from the standpoint of being considered as a big investment. Only a short time ago the speaker watched the wheeling of a heavy engine by air jacks at one of the shops of a big railroad where he once had the honor of employment. This would be impossible if the locomotive or the shops were considered by that road as a big investment. Let us hope that an able, quick crane has replaced the dangerous sluggard jacks and time and man killing wooden blocking. Fortunately,

shops as well as locomotives may be modernized if there is a will to do it and if the policy of doing it is established on a stable basis. Bear in mind the fact that increasing the number of new big engines without increasing shop and roundhouse facilities is fatal as a business policy.

Maintenance of way officers are now engaged upon the establishment of units for comparison of track repair cost, and great improvements in track maintenance costs are expected. If costs of various locomotive repair shop jobs were compared upon a fair and really comparable basis, many shops with high costs could be put on the basis of the best shops. Improved machines, rearrangement of machines and improvement of methods, with reduction of distance traveled by material and parts, would certainly result. Many shop operations are subject to comparisons that would be intelligent and fair, but only items which are subject to fair comparison should be selected. There are many of these, and if the facts that comparisons would reveal are put up to the managements strongly, machinery fifty or more years old would disappear from our shops and roundhouses because it cannot be modernized.

In the matter of shop production methods this Association would do well to discuss the paper upon Graphic Production Control read by Mr. E. T. Spidy, of the Canadian Pacific Railway, January, 1920, before the Canadian Railway Club. Officers who desire to make a good record should study it. If Mr. Spidy's "up-to-the-minute" shop information were also applied to locomotives and their operation, railroad stockholders and the public would be happy indeed. Careful attention to the excellent report by the Committee on Shop Scheduling Systems, to be presented at this convention, is earnestly recommended in connection with the reduction of overhead.

Stitch in Time Terminals

Locomotive terminals are not all equipped to handle expensive engines promptly and economically. Has anyone charted or scheduled locomotive terminal movements with a view of short cuts in delays? Are big engines ever held in yards and sent in herds to the roundhouse for fire cleaning, coaling, sanding and roundhouse jobs, when they could as easily be sent singly to keep the roundhouse load curve more uniform? Because the "stitch in time" at the roundhouse may keep a big engine going strong, the best of mechanics and the best of tool equipment should be at the roundhouses. Is this so today? Unquestionably the round house foreman should be a man of greater authority. It would seem to be a money making scheme to give him much better standing, also to give him a yard foreman to handle the firing up of engines and all the out-of-door work, to speed up ash pit and other work that delays expensive engines from the road. An inspector who has been a locomotive engineer should meet all incoming engines and discuss with the crews the condition of the engine and the defects found. These men would save their annual pay every month. It would be very profitable to have traveling engineers spend a day or so every month at the roundhouse.

Adequate locomotive terminals laid out, organized and equipped for quick, thorough work will speed up the entire railroad. Inadequate terminals do more than anything else to slow down the entire railroad. Furthermore, locomotives may be designed and equipped for quick terminal work, particularly at the ash pit. Who knows how many new locomotives might be saved by quickening terminal operations?

Better Use of Power

In locomotive operation lies a fruitful field for study and improvement. Mileage of passenger and freight runs is an item of importance. Water and coal stations that were established years ago upon the basis of engines which did not have the advantage of modernizing factors may in many cases be relocated with profit. Why should not passenger divisions be extended to 300 miles and freight divisions to 200 miles? There are difficulties, but are we sure they can not be overcome? It is much better to change crews and much cheaper than to let the engine go to a terminal so often. Is it possible to double the mileage between roundhouseings or to cut in halves the time waiting for the ash pit?

As to terminal delays, have conditions improved greatly since N. D. Ballantine recorded, before the Western Railway Club five years ago, the results of an investigation of locomotive service which showed that the mechanical department had the en-

gines 58.5 per cent of the time, and of the balance of the time 65 per cent was occupied between terminals and 36 per cent in actual running. Mr. Ballantine revealed an opportunity for remarkable saving by lengthening locomotive divisions that this Association can profitably discuss.

Coal Will Never Again Be Cheap

Individual fuel records have been advocated for a quarter century and some success has come to those patient enough to persist in this direction. Coal costs are already high enough to justify this and many other improved methods, the importance of which increases with coal costs and with the amount of fuel a big engine burns. For example, one reason for the delay in adopting feed water heating is that coal has been considered cheap. Coal must now be considered as a big investment. Fuel is no longer cheap, and in the quantities required to haul the big tonnage that is coming it never again can be cheap. Natural gas was once considered cheap. Think of the result of such opinion.

Government experts have performed wonderful work in the use of fuel. This work will be continued by individual roads, and when it is coupled with systematic application of modernizing factors to old engines the results will appear to their full value. However, fuel saving on an obsolete engine is like trying to save water that has gone over the dam. Put flash boards of modernizing on top of the dam and save that water for the wheel that turns the mill.

"Follow Up" Policies

A very wise policy has been followed for years by a motive power official who is well known among you. He believes in following up the items of maintenance upon his locomotives. For every item, for example, injectors and rod packing, and the fuel and labor saving factors, staybolts, springs, tubes, annual expenditures for which reach or exceed \$100,000, he assigns an expert service man, reporting to him, whose duty is to insure the proper application, maintenance and use of the items in question. If every road would follow up its \$100,000 investments in this way wonderful savings would be effected and many an engine would go out on its run instead of being held by government inspections. You know and I know what the railroads owe today to the service organizations the supply companies find it necessary to employ to insure the most efficient use of their devices. This service rendered by these companies has made the big modern efficient, economical locomotive possible. The time has come for the railroads to render these service organizations less necessary than they are today. Some years ago the writer saw the mechanical superintendent of an English railway "hit the ceiling" when a freight engine went past his office window with its piston rod packing blowing. We have much to learn concerning the value of keeping worth while improvements up to their best work. We do not worry enough about things that leak and things that may grow into engine failures.

Another fertile field for modernizing is the railroad power plant, shop plant and pumping station. These use enormous amounts of fuel in the aggregate and are proverbially wasteful. Records may be made and very easily by rounding these up and by modernizing power plants. In one case, by merely charging up the coal a plant burned, a 25 per cent saving was made. It was saved by showing that fuel is an investment.

Men who make great business successes are said to be brainy—they are brainy, but they are more than that. The number of men who know how to do things and who recognize opportunities is greater than the number that actually do them. Success comes from persistent pushing to conclusions the plans that brains conceive. Those who have won great success in modernizing locomotives are the ones who not only recognize the opportunities for applying to old engines modernizing factors that make for more ton miles per ton of metal and per ton of coal, but those who persist in definite plans for doing it. They are the ones who will take high standing in economy of locomotive operation because they schedule and program their improvements that make for higher capacity and economy.

Safeguard Money Already Spent

By spending a few thousands in modernizing, millions of dollars already invested in locomotives that are ten or more years old will return more service. These old engines stand as

a big non-paying investment. Spend the little that modernizing costs and change them into a big paying investment. A manufacturer must scrap his obsolete machinery. How much more fortunate are the railroads. They may at little cost reclaim their locomotives by methods that make them often 50 per cent better than when they were built. We should not consider a ten year old engine in the light of its depreciated value. Many of them will sell today for their original cost. On this basis they are all the more worth modernizing.

Suicide

Without question the greatest locomotive investment, and one which can not be expressed in dollars, is the organization for locomotive design, operation and maintenance. Organization constitutes the greatest opportunity of all. Constructive, consistent and persistent personnel plans are imperative. The problem is simple but the solution must be comprehensive. Every railroad should see to it that employees are (1) selected wisely, (2) trained properly, (3) promoted by merit from intimate knowledge of performance, and (4) promoted from the inside to fill all important prize positions.

To this end apprenticeship must be revived and applied to all departments in a form adapted to the great need of the times and the graduates from apprenticeship must be kept on the road by intelligent, systematic personnel plans. The plans referred to will supply every position including those requiring special technical education. Railroads will not be forgiven for neglect of apprenticeship. They are having their punishment now for neglect of it. Have you been making your quota of skilled mechanics all these years? Is one apprentice for every 18.58 mechanics, the country over, safe? Have you studied your labor turnover and made plans to reduce it? Labor is a big investment, and labor turnover is a big loss.

Vision

Vision as to conditions, possibilities and the future development is the great need now. Who is to have the vision to correct the tendency—already acquiring momentum full of danger to the railroads—for the mechanical departments to drift down to merely practical maintenance organizations?

That this Association has the power and the opportunity to bring about a proper recognition of the locomotive problem is one of the hopeful factors for the future. But this organization must get above the smaller questions and into the business questions of the pulling power of railroads, and must do it quickly.

No group of men ever had a more glorious outlook before them. No group ever had a better and stronger incentive; and no problem could possibly be accompanied as this one is, with the means ready at hand for its solution. The task is to study conditions, use factors and facilities that are all ready at hand and assist the development of new ones. The outlook is most promising, hopeful and encouraging; but quick, hard work is necessary because the situation as it stands today demands the best we have.

What are you going to do about the eight hour day? Time and a half for overtime? 100 to 200 per cent increase in wages? 100 to 200 per cent increase in fuel cost?

What are you, the individual, going to do? You know the conditions and the remedies. Put them before your superior officer in a convincing way—with a foundation and structure of facts. Give them the arguments that will get the money necessary to economical operation.

Nothing that lies ahead is as difficult as the pioneering that gave the country its wonderful railroads.

Discussion

In the presentation of this paper Mr. Basford made the following remarks: If the railroads are to stay out of the hands of the government, a lot of people have got to wake up. Mechanical department problems must be recognized. Mechanical men must be listened to. On the other hand, the mechanical men must wake up and tell what they know, and tell what they need, and get it. (Applause.)

You have the strongest argument in the world for the mechanical department problems. If the power is right, it is easy to run a railroad. No one can run a railroad without the power in good condition. If anybody can get what they need in the way of appropriations, help or anything else, you can. I think

it is your own fault when you get turned down. Everyone of our 66,000 locomotives must pull more tons per turn of driving wheels, and must make more turns.

Chairman Tollerton: I think a vote of thanks is due Mr. Basford by the Association for the very wonderful paper he has presented, and while he has told some plain truths, it is something I think that all motive power men have realized for years. The railroads of the country have been confronted with a very difficult problem. It is unnecessary for the Chairman to elaborate what that problem has been, but with railroads, like individuals, if they haven't money to buy they have got to get along the best they can with what they have got. However, as stated in my address, the new Transportation Act has provided a means by which this money will be secured, and the railroads of the future must be run as a business showing a profit. If it does not do so, it is a direct tax on everyone.

F. W. Brazier (N. Y. C.): I feel something like a duck amongst hens, in the midst of you brilliant motive power men, I being strictly a car man. I was going to make the motion that a vote of thanks be extended to Mr. Basford for his very able, wide-awake paper, and then I want to roast you motive power men a little mite.

You come here to these conventions for what? For educational purposes. But you sit here like the Scripture says—"Why sit you here idle?"—why don't you go to work, why don't you express your opinion?

I attended a meeting of motive power men a few years ago and your able vice-president, William Garstang, whom we all love and reverence, got up and said that on the Big Four Railroad his officials would always give him all the improvements that he wanted as long as they didn't cost a damn cent. Now, that is just the position that you gentlemen are all placed in. Mr. Basford's paper is brimful of light, and he ought to be the general superintendent of motive power of the United States of America, and put some life in all the officials.

C. E. Fuller (U. P.): Knowing Mr. Basford as I do, and knowing he is very, very bashful, I was particularly pleased to hear the paper which he presented to us this morning, which is so full of interest, there are some things that he said that I think it would do us all good to take home with us, and to think them over, and study them, and one of these things is: have we been consistent with our people? Have we stood on our feet? Have we had the courage of our convictions? Have we told the story as it should have been told?

I believe that if you will take this paper which has been presented this morning, and study it, and commune over it, you will find that the disease, or the germ of the disease, is in our own body. We have not, to a large extent, gone to our people and represented to them in a forceful, plain and convincing manner what we require, what we should have, and our reasons for having it. In other words, some of our executives have been stronger than we have been, and we have been timid and weak-kneed.

Mr. Basford's paper, if it has the good effect that I feel it ought to have, will help the mechanical department more than any one thing that has ever been said at this or any other convention of this Association.

Frank McManamy (U. S. R. A.): I feel that this Association is to be congratulated on having this paper presented to it, but I do not think that we should leave this meeting with the impression that the paper was intended to make the railroads spend more money. My view of the paper is that its purpose was to save money for the railroads, and every matter which Mr. Basford has mentioned will actually pay the biggest dividends on the investment that any money spent by the railroads can pay.

I think we should not overlook the fact that the only thing the railroad has to sell is transportation, and without motive power we have no transportation. Therefore, we are destroying our own merchandise and failing to lay in a new supply if we do not make proper provision for taking care of motive power, which is the only thing that brings in the money to the railroads.

The railroad men of the country have not done their full duty toward supplying labor for the departments they represent by simply hiring the men who come along, a comparatively few, and no railroads have made sufficient provision for providing a supply of efficient mechanics for the future. I speak of this matter, because within the last year I personally made a canvass

of every railroad in the country, and the conditions which I found are set forth in Mr. Basford's paper; that is, for the entire country there was a ratio of 18.5 mechanics to 1 apprentice. We have said that the ratio of 1 apprentice to 5 mechanics, which has been requested by the shop crews, which is incorporated in most of the schedules, will not furnish sufficient mechanics. In my opinion we do not know because we have never tried it.

In some trades we have as low as 1 apprentice to 300 mechanics, and on some railroads we have as low as 1 apprentice in all trades to 31 mechanics. These are conditions which the mechanical department officials must take steps to correct. It is not enough that we put on the apprentices when they apply, but a careful canvas must be made of the employees to get the apprentices. If the rate of pay is not sufficiently attractive to provide the requisite number of intelligent and able apprentices, or apprentices that will qualify for a trade, then the rate of pay and the working conditions must be made more desirable.

When we get the mechanics, the point brought out in Mr. Basford's paper, that we must have suitable facilities to take care of the work, becomes more important. Never again will we have cheap fuel, which emphasizes the necessity of proper maintenance of locomotives. I think that he could well have said, that never again will we have cheap labor, and, therefore, some of the roads which have been able to maintain their

equipment with economy with mechanics at 30 to 40 cents an hour, and common labor at 17 to 25 cents an hour, and apprentices at 12 to 21 cents an hour, will find the same methods of maintenance very wasteful and expensive with the wages of mechanics running to 85 cents to a dollar an hour.

There is only one way in which we can economically maintain our power, and that is by improving facilities. Such expenditures will afford the biggest returns.

We have spoken of the expense of building shops. I know many cases today where the money spent for the last order of locomotives could have been much more profitably spent on improving the shops. When you have 20 to 25 per cent of the motive power standing idle it does not help matters permanently to buy more locomotives. You simply add to the congestion, to the investment, to the running expense, and handicap your mechanical department.

When conditions of that kind exist, instead of ordering new locomotives to tide you over a period of heavy business, the thing that ought to be presented to the officials is the necessity of providing facilities to take care of the motive power they have.

A motion that Mr. Basford's paper be received and the Association thank Mr. Basford for the paper, was seconded and passed together with an amendment to the motion that the paper be printed in pamphlet form and sent to the executives of every railroad in the United States and Canada.

Design and Maintenance of Locomotive Boilers



THE ASSOCIATION ADOPTED a resolution in connection with last year's report referring the subject of combustion chambers to this committee. Forty-five roads have replied to questions contained in this year's circular.

Water Glass Fittings and Mountings

Out of the 45 roads making replies, 27 use tubular water glass, 14 the reflex and 4 report using both. Comparative tests of the tubular and reflex glasses have been made by four roads. One states that the reflex water glass after test was found no

better than the tubular; another, that the tubular with a protector was found more satisfactory; still another, that the tubular has less visibility but lower maintenance cost, and another road reports that after trial the reflex glass was regarded as unsatisfactory. These tests in a general way appear to favor the tubular glass, although it is conceded that both types of glass have their adherents, and it is likely that local conditions have a great deal to do with this question. No valid objection can be taken to either type of glass where properly installed and maintained.

Regrinding of reflex glasses was reported as successful by four roads, with fair results by two, and without success by three. The cost of regrinding was reported as varying from 7½ cents to 45 cents per glass. Regrinding reflex glass is of questionable value.

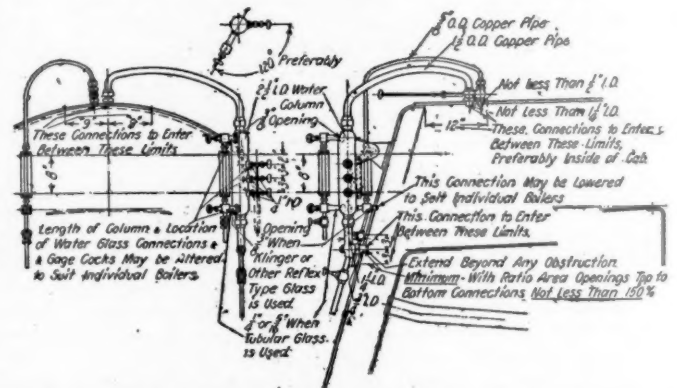
Specifications for use in the purchase of gage glasses were reported as not used by 3 roads and in use by 6, 4 of whom use specification prepared by the New York Central. The Pennsylvania also has a specification which has recently been adopted by the Union Pacific. A test of the various bulls-eye tubular and reflex glass by the digester and dipping methods will readily convince the observer of the necessity of such a specification, and it is the recommendation of this committee that the Committee on Specifications for Materials be requested to prepare a specification for gage and water glasses for this association.

No trouble was reported from packing washers expanding and

clogging the passages. The precautions taken include care in packing, the use of a proper design of connections and repacking at regular intervals, if necessary.

WATER COLUMNS

One road regards the water column as superior to all other arrangements; 11 state that the water column furnishes true readings; 6 state that the water column is satisfactory; 5 regard the water column with disfavor, while 5 state that the water column is not satisfactory. One member states that he believes the water column does not give true readings, and another states that there is a siphon action when gage cocks are open, which causes the readings to vary as much as 5 in. or 6 in. from the true water level in the boiler. In commenting on the latter



Arrangement of Water Glass and Gage Cocks Approved by the U. S. R. A. Committee on Standards

statement, it is the belief of the committee that some other unusual and undesirable condition existed, such as insufficient opening or proximity to a water tube.

With the usual types of modern wide firebox boilers having sloping back head, and generally provided with arch tubes admitting large volumes of steam into the back water space, the committee believes that in order to obtain more accurate readings the application of gage cock and water glass fixtures deserves careful consideration, and presents as recommended practice of the association the arrangement of water glass and gage cock as developed and approved by the Committee on Standards, at

Washington, and as illustrated by their Drawing X-100 reproduced in this report.

Standard Practice for Beading Tools

From a comparison of the drawings of beading tools submitted, it appears that the essential detail of the tool is the throat or surface from which the bead is formed. In some cases the tool is shown straight in the circumferential direction of the flue. The curve in the radial plane of the tube determines the radius of curvature and the size of the bead. In most cases a slightly larger radius for beading tools is used on superheater flues than on ordinary boiler tubes. In some cases the same tool is used for both classes of tubes. Some use a slightly different tool for maintenance of tubes than that used in resetting new work, thus making at least four different beading tools.

For beading the regular boiler tubes, the radius of curvature reported for beads varies from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. The radius of curvature of the throat of the tool in the other direction is usually made the same for boiler tubes and superheater flues, and varies from $\frac{5}{8}$ in. to 2 in., although, as stated above, some were made straight. There is no essential reason for all of this variation, except the variation in the size of the bead, which is a function of the thickness of the flue. Practically all beading tools are maintained to size by regular periodical checking with standard gages.

There is considerable variation in the details of the methods of expanding flues. Most roads use both the roller and the prosser expander and follow closely in details of tools and in practice the recommendations of the Locomotive Superheater Company.

A wide variation of practice exists without any apparent reason, and the committee asks the views of the association as to the advisability of preparing and submitting next year a set of tools and operations for setting, beading and maintaining tubes and flues as recommended practice.

Proper Location of Blow-Off Cocks

The number of blow-off cocks in use per locomotive varies from one to four. Some report blow-off cocks located on the belly of the cylindrical part of the boiler but most of them are located on the water legs about the firebox. Some have one cock on each side of firebox with one on the throat sheet at the center. Some have only two blow-off cocks, one on each side of firebox, sometimes located near the center of the side, and possibly more frequently near the front corners. Two roads reported the use of a single blow-off located on one side at the back corner of firebox, and connected to a perforated pipe lying along the mud ring in the back water leg under the fire door. Quite a number report the use of one blow-off cock located over the mud ring at the center of the throat sheet. The number and location of blow-off cock is determined to a considerable extent by the kind and quality of water used for boiler feed.

Very few failures, or troubles, with any of the blow-off valves in use were reported. To reduce the danger of obstruction from scale and sludge, a great many blow-off valves are provided with some form of strainer. One road places the valve about 12 in. above the mud ring with the idea of leaving the scale in the water leg below the valve when blowing off.

The practice of blowing off on the road is employed only by those roads where water conditions make such practice necessary. The recommended essentials in construction to permit blowing off and closing on the road are a valve rigging operated from the cab or a safe position on the running board, the valve located in view of the operator and designed so that the boiler pressure will assist in closing and hold it to its seat. An auxiliary valve should be provided that can be closed in case the main valve fails. There should be a strainer to prevent scale and other obstructions from lodging in the valve. The valve should open full, have straight full passage, and be rigid in construction and positive in action.

Combustion Chambers

The number of engines reported with combustion chambers was 2,152, with chambers varying in length from 5 in. to 88 in. Of these about 300 are reported with back flue sheet welded in place while the others are riveted. Out of 23 roads reporting combustion chambers 18 use a transverse weld across the crown sheet at the rear, but 6 of these express a preference for con-

tinuous crown sheets, and the intention to apply them on renewals.

One road with about 200 combustion chambers, is of the opinion that the cost of maintenance overbalances any fuel economy obtained from their use. One road states that the combustion chamber permits of construction of longer boilers than otherwise would be practical. Another, without definite tests, can see no advantage in the combustion chamber over those of other designs. Three believe that flue troubles are reduced from the application of combustion chambers, and 11 report a belief that fuel economy is obtained from their use.

Troubles reported from combustion chambers include the collection of cinders in the chamber resulting in the warping of sheets. Six have reported trouble from cracks in the throat sheets, one reports trouble from broken stays on long combustion chambers, which was corrected by the application of flexible stays, another reported trouble in keeping the water space under the chamber free from mud; one is of the opinion that the trouble from combustion chamber increases the cost of maintenance; ten report no troubles in maintenance; one reported some trouble due to faulty design, and one says flue sheets are easier to apply with combustion chambers.

Six roads reported experience with bridge walls, three of which were of the opinion that they are desirable and three were not. One thinks a bridge wall should be used only when necessary.

One road is of the opinion that the combustion chamber is essential in aiding the distribution of weight on large engines, one that it has little effect, and fourteen consider that it is not essential for that purpose. It is the view of the committee that on large modern engines a combustion chamber is practically a necessity as a factor in proper wheel base and weight distribution, proper length of tubes and superheater equipment, and that the additional direct heating surface of the combustion chamber added to the firebox heating surface is of distinct value in aiding evaporation. If the use of combustion chambers is attended by increased maintenance, this has now become a necessary evil attending the large locomotive, and these so-called evils can be largely reduced by proper design and proportion.

The minimum distance from crown sheet to inside of wrapper sheet is given as 25 in. by one, $23\frac{1}{2}$ in. by another, and 20 in. by one. Some vary the distance with the size of the boiler, two giving the rule of making it equal to 15 per cent of the diameter of the largest course; four endorse the standards followed by the locomotive builders, and eight have no standard practice. In regard to lowering the crown sheet at the expense of the heating surface, fourteen do not consider it justifiable, while two roads do, if necessary to maintain the standard minimum, and four state that it would depend upon the design.

The recommended minimum distance between bottom flues and waist sheet varies from 2 in. to 7 in., and one recommends 10 in. with combustion chamber.

To lessen the entering of water into the dry pipe, fourteen report the use of no special devices for this purpose, while four use a special throttle with inlet at the top of dome.

Three roads report on the test of special devices for promoting water circulation in boilers, two of which gave unsatisfactory results, while one claims economy by the use of the Harter circulator plate for promoting water circulation in boilers. The latter consists of a horizontal baffle plate extending from side to side of boiler and from about two feet from the front flue sheet to within six inches of the back flue sheet. It has a series of two-inch tubes at intervals along each side to conduct steam formed beneath the baffle to the space above.

The Nicholson Thermic Syphon is also referred to as a water circulating device, with the details of which all are undoubtedly familiar.

Recommendations

The committee recommends the presentation of a specification covering tubular and reflex water glasses, and bull's-eye glasses for lubricators.

The committee endorses water glasses and gage cocks applied to modern boilers in accordance with method approved by Committee on Standards, and here shown.

The report was signed by C. E. Fuller (Chairman), Union Pacific; A. W. Gibbs, Pennsylvania System; C. B. Young, United States Railroad Administration; Joseph Chidley, New York Central; W. I. Cantley, Lehigh Valley; J. Snowden Bell, and J. T. Carroll, Baltimore & Ohio.

Discussion

In presenting this report, the chairman of the committee said:

We have found in tests of glasses under various service conditions, that quite a large amount of inferior glass is being sold to the railroads, both reflex and tubular. The glasses will not stand up and their life is very short, and we believe that we would all save money by subjecting all glasses to proper tests.

A. G. Pack (I. C. C.): The question of proper water indicating devices on the modern locomotive especially has been brought to the attention of the Bureau of Locomotive Inspection for the past five years, due to the number of crown sheet failures where no contributory cause could be found other than low water. As a result of this, we have been making a number of observations and investigations under the actual operating conditions to determine what effect the circulation of water was having on the water glasses and gage cocks while under severe operating conditions.

The question was brought to the attention of this Bureau in 1914 on a road using oil for fuel, where there was a great deal of damage to crown sheets and melting of fuseable plugs. The enginemen declared they were doing this when two and three gages of water were shown by the gage cocks and the water in the water glasses was in such severe agitation that it was difficult to read them.

In that particular instance we found that the boilers were of the crown bar type, using oil for fuel with a front end burner, which severely impinged the heat on the back head and back end of the crown sheet. The back head was braced by a transverse T-iron, about in line with the back end of the crown sheet. When the safety valves opened, or the throttle valve was opened and the locomotive in operation the gage cocks filled with water, regardless of where it was registered by the water glass.

The standard water glass application had a top connection near the knuckle on the left side of the back head, with the water glass standing in a vertical position, and the gage cocks were in the back head near the knuckle in the flat portion on the right side.

Moving the gage cocks toward the vertical center line of the boiler, practically remedied the gage cocks registering a higher level of water than actually prevailed. We believe that was caused by the T-iron acting as a baffle plate and breaking the current of water moving up the back end and around the firebox. The water glasses in that instance were moved in so as to get away from the knuckles where the water evidently circulates higher than it does toward the center of the back head.

We had a water glass applied on the left side near the front end of the crown sheet, attached on top of the boiler, with the lowest reading one inch above the crown sheet. After making the changes mentioned, we got nearly comparative readings between the three devices.

The matter has been called to our attention from time to time that gage cocks were registering incorrectly, and last October the question was brought up on a certain railroad in the East, operating some large locomotives. The gage cocks, attached to a column, would fill up when the throttle was opened, regardless of where the water might be, and the water glasses were filling up when they reached the level of two to three inches when the throttle was opened and the locomotive began operation.

Our first test clearly illustrated that the point of connection to the boiler had a material effect on the water glass reading. In the next test, we had three connections made to the water column. And a water glass attached to the column, so that we could get readings between the gauge cocks. We had some gauge cocks applied in the back heads, screwed directly into the boiler using two and three water glasses applied in the usual manner each with two connections to the boiler. We could vary that reading as much as six inches by opening one valve in the connection and changing to another, and vice versa. And by changing from the connection in the back head to the one in the knuckle we could drop the water six inches in the glass instantly, and it would work normally until it got five inches of water in the glass. By closing that connection and opening the one 12 in. ahead of the knuckle, the water would immediately recede and work normally, indicating that the circulation of water was going up the back head to a sufficient height to fill the glass from the top connections.

To develop what was taking place in the boiler, a locomotive was equipped with sliding tubes that could be adjusted to 24 inches, and in that instance, in a remarkably good water district, it was developed that there was a flow of water up the back head when the locomotive was working ordinarily hard pulling a train. The fountain effect raised the water at the base to a point 12 in. out from the sheet. Three inches higher it was 9 in. thick, and 8 in. higher there was just a flutter at the back head, indicating that the water was banked up against the back head. With two inches of water indicated in three water glasses, the gauge cocks at the knuckle registered eight inches more water than either of the water glasses. In the center they showed six inches higher than was registered by either of the water glasses.

As an indication of which of these is the more nearly correct, we have taken into consideration where the greatest variation takes place when the throttle is open and closed. We have all assumed that when the water raised in the boiler it rose uniformly and not just at the back end. To further develop what was taking place, we went to a Western section of the country, where the water was extremely light and foamy. Their standard equipment was three gauge cocks. Another gauge cock was applied, also a water column, to which a water glass and three gauge cocks were attached and four adjustable tubes measuring a depth of 24 inches and a water glass with a steam pipe connection to the boiler on the left side. When working steam with the standard water glass entirely full, the four standard gauge cocks all showed full of water, while the gauge cocks supplied in the column, the water glass attached to the column and the water glass applied for experimental purposes would retain a water level of one inch. When the throttle was closed and the water agitation ceased, the column and glass and the experimental glass still retained the same level of water, or approximately so; while the water dropped as much as 8 in. on the standard glass and gauge cocks.

It was developed in that case that the extreme height or flow of water up the back head reached as much as 10 in. above the general level of the water in the boiler. That is not registered by the water glass, but is registered by gage cocks when screwed directly into the back head.

The question has been frequently asked, why that flow of water does not register in the water glass. The only reason that I can assign for that is that the water is held in that position due to its velocity, and has no static weight.

Do not understand me as saying that water glasses when properly applied and maintained, do not always register the correct height of water in the boiler, but they are subject to ailments which are more or less neglected. It is a great misfortune that we cannot find some better way of packing water glasses than with an ordinary rubber gasket. It has been our experience, in examining a great many crown sheet failures, that the water glass circulation is sometimes entirely shut off, and very frequently retarded by rubber gaskets being squeezed over the ends of the glasses, which render them unreliable.

To further demonstrate what we have already discovered, we placed a 75 watt light in the interior of a boiler under steam pressure where we could watch the agitation of the water and the circulation. By using a tube tested to 400 lb. pressure and 400 deg., and sight glasses we could see in over the crown sheet and at the back end. This test was made on an old boiler built about 25 years ago, with the vertical back head and O. G. firebox. In that case we could observe the water flowing up the back head. When the throttle was opened and the circulation started, as much as four inches registered at the gage cock but not at the water glass. It flowed up around the sides of the firebox but not to as great an extent, and up the front end of the firebox, but as much as it did on the back end.

We have had a number of tests of the water column. There are three or four roads that have used the water column quite extensively and trouble has been found in some instances where the gage cocks siphoned the water as much as four or five inches when opened wide and left open for a considerable period. That is objectionable for the reason that many engineers when they let the water go out of sight in the glass, will open the gage cocks, and go to any extremes to find water. We would like to make those things as nearly fool-proof as possible.

We believe these devices can be made to register the water accurately by a properly designed and applied water column.

The design which we have found ordinarily meets the requirements is a column of $2\frac{1}{2}$ in. internal diameter with a $\frac{3}{4}$ in. bottom connection into the boiler and a steam connection to be made as short as possible, free from short bends or traps, with an internal diameter of not less than $1\frac{1}{4}$ in., preferably larger. I want to bear particularly on that. A $3\frac{1}{2}$ in. column, with a 2 in. steam connection, if the locomotive is so constructed that it can be applied will remove the siphoning effect entirely, provided the gauge cocks are kept down to a standard that will serve the purpose— $\frac{3}{4}$ in. internal diameter. Some roads are using gauge cocks with $\frac{3}{8}$ in. openings. The effect is pretty nearly like opening a blow-off cock when one of them is opened wide, and, when the equilibrium in the column is disturbed the water is raised.

There is another very important subject that I want to touch on. We made an investigation two weeks ago on one of the United States standard Mikado type locomotives that had had the crown sheet damaged three times in the last year due to low water. The last engineer that got into trouble over it, had been running for many years and was considered one of the most reliable men. Having heard of the investigations we have made, the road called on us to see if we could find something wrong with that particular locomotive. We found that the gauge cocks registered five inches more water than did the properly applied water glass.

We had a water glass applied with a connection on top of the boiler near the vertical centre line of the back head, and it showed that the left water glass was registering two inches more water than the newly applied glass, and the right one $3\frac{1}{2}$ in. more water, and the gage cocks 5 inches more.

As probably a majority of you know the top connections on the government engines are made through a street-L. The only thing that was wrong with these water glass cocks was that they turned the street-L around until a small pocket was formed, and when the water of condensation filled in, it caused the glass to fill. When blown out, the level came down and registered, apparently correctly but it would gradually fill up until it rendered the reading unreliable. That clearly illustrates the importance of avoiding any traps or short bends in top water glass connections, where the water of condensation may collect.

Personally, I believe that the water indicating devices are among the most important devices on a locomotive, from the viewpoint of safety as well as economical operation. If you expect to get economical operation, you must provide the engineer and fireman operating the locomotive, an easy method of knowing at all times where the water level is in the boiler. There is no fireman who can economically and successfully fire a locomotive unless he keeps track of the water level in his boiler, and the engineer must know it in order to successfully and economically operate a locomotive.

A water glass so located and constructed that a man has to study for 30 seconds to a minute to read the water in the glass, is evidently not going to be looked at as often as it would be if it is placed in a convenient location. He is not going to look at it as often as he should. If he does, he is neglecting something very important.

The matter of water circulation in the boiler is one that has been given very little study. This matter was brought to the attention of the Bureau of Locomotive Inspection in 1913. As a result of that, one of our inspectors made a miniature boiler, about 12 in. in diameter and 36 in. long that carries 30 lb. of steam with sight glasses in it, so that we could see the circulation of water. It showed the movement of the water practically as I have described it, and I have not found anything from practical demonstration that changes our theory of the water circulation in the boiler, and that gage cocks when screwed directly into the boiler do not correctly indicate the water level in the boiler, while steam is being generated and at the same time escaping. I have a full set of plates here, and I have a full description of the more extensive tests made, that I would be very glad to furnish the Secretary. I have gone sufficiently into detail in the matter, so that it is worth while for any mechanical man to study, and I have anticipated having it printed

in pamphlet form, so that I might distribute it among the engine men. It is a very important matter for them to know what takes place in the interior of the boiler because it is an entire reversal of anything that we have ever been taught before.

Chairman Tollerton: The committee in its report mentioned combustion chambers. The Northern Pacific has probably had more years of experience with combustion chambers than any railroad that I am familiar with, and I would like to ask Mr. Curry if he won't give his experience with them.

H. M. Curry (N. P.): We adopted combustion chambers on our heavier power about 15 years ago, and we have without exception, had all of our engines equipped with that type of fire-box since that time. We have gone further and changed, as new fireboxes were applied, all of those that were originally equipped with boilers with long flues, and we would not think of discontinuing the use of combustion chambers. We were very greatly surprised and pleased at the marked economy in coal consumption derived from the use of engines equipped with combustion chambers in comparison with those equipped with long flues without the combustion chambers, and after we became familiar with the proper manner of maintaining the combustion chambers, we found that the trouble we had experienced with the long flue engines was very materially reduced by the use of combustion chambers, which, of course, permitted the use of considerably shorter flue.

R. W. Bell (I. C.): I doubt if there is anyone present who has had an earlier observation of combustion chambers than I have had. We had in 1863, on the Baltimore & Ohio, two combustion chambers, both of which were found unsatisfactory and were subsequently taken out, but from my observation of them then my opinion was, and it is now, that the only objection was one of design and workmanship. In those days we did not have welded seams or any facilities for work that we have now. I feel very well satisfied that the conclusions of the committee are correct, to the effect that combustion chambers do promote combustion and do bring about fuel economy, and that any failure to do so is due simply to a matter of design. Design is a matter which we ought to be able to perfect, and I think we can and will perfect it.

M. H. Haig (A. T. & S. F.): In looking over the committee's report, my attention was attracted particularly by the comments on water rising in the water column when the gage cocks are open. The object of the water column is the introduction of a device that will register the height of the water under all conditions more accurately than it is believed to have been done in the past with gage cocks applied direct to the boiler back head. There seems to be an impression on the part of locomotive engineers that gage cocks register the height of water more accurately than the water glasses. Therefore, it is very essential that the gage cocks shall not be misleading by raising the height of the water higher than it actually is.

In a series of trials in which the representatives of the Federal Boiler Inspection Bureau took part, it was found that with a comparatively small size of water column body there was a tendency for the water to rise when the gage cock was off. For example, with $\frac{3}{16}$ in. gage cocks, the water would be seen to rise, especially when the locomotive was working. With $\frac{1}{4}$ in. gage cock the water would rise still higher. After these initial trials were made, a larger water column was tried. The body of the water column was $3\frac{1}{2}$ in. in diameter, and inside diameter of the pipe at the top was 2 in. and the connection to the boiler at the bottom of the water column was $\frac{3}{4}$ in. In a water column of these dimensions it was found in opening the gage cock two complete turns, the water would not rise more than $\frac{1}{4}$ in.

To further demonstrate the effect of the proper dimensioning of the water column, trials were made with two of the gage cocks open. Two complete revolutions, and left open two minutes. The reduction of the water was not such that it would be noticed during the ordinary movement of the locomotive.

The dimensions which I have mentioned show very conclusively that the rise of the water accompanying the opening of the gage cock could be eliminated. Also it was believed that the matter of condensation which would result from long pipes or bent pipes had some effect, and therefore the pipes were

made as short as possible, were thoroughly lagged, and, as Mr. Pack pointed out, the pockets were entirely eliminated.

S. Zwright (N. P.): I may say a few words. The first engines equipped with combustion chambers on the Northern Pacific were received in 1902, and we had trouble with the combustion chamber seam on account of the heavy lap. After we chamfered this off and cut away excessive material it did away with the checking or cracking of the seam from the rivet out, and that practically stopped that trouble. Whenever we can provide it in modern engines, we have a continuous sheet, and in that way eliminate a seam.

We have on our system many locomotives of the same kind and the same class of service without the combustion chambers, and the flame plays directly on the bead of the flue, expanding it to the limit and then when the cold air

comes in contracting it again, and we have leakage. When we convert them to superheaters, we also apply the combustion chamber, and we eliminate the flue trouble, and we get very much better results from the standpoint of economy, maintenance and fuel consumption than we did with the long flue engine.

Mr. Haig: I have seen quite a lot of the information prepared by the Federal Boiler Inspection Bureau, and I would like to suggest that Mr. Pack be requested to prepare a paper for presentation next year, which he can illustrate with slides, and give the members of the Association the benefit of the information he has gathered, because I know that information is very instructive.

A motion that the report be received and ordered printed was seconded and adopted.

Report on Engine Terminals, Design and Operation



ON FEBRUARY 20, 1920, the committee issued Circular No. S-III-100, containing twenty questions and a request that all replies be in the chairman's office by March 15. Up to the date of preparation of this report eighteen roads responded to the questionnaire. However, the information received from the majority of roads responding was of such a nature that no general conclusions or recommendations can be presented and the following is offered as a progress report:

The length and capacity of ash pits is determined by the maximum number of engines handled in twenty-four hours.

One road recommends an ash pit of suitable size to take care of 50 per cent more power than is being handled, so that if the ash pit conveyor is out of commission temporarily the ash pit will be of sufficient capacity to hold cinders until repairs are made. Two roads recommend two large water cinder pits emptied by locomotive cranes, with grab buckets operated from a separate track, the pits so arranged that cinders can be flushed into cinder pit from the dump pit with water. Three roads favor a depressed track for holding cinder cars, located along the side of pits in order that cinders may be easily shoveled into the cars.

The capacity of the coal chute depends upon the maximum number of locomotives to be coaled in twenty-four hours.

Seven roads specify the coal chute, sand house and ash pit to be located between the inbound and outbound tracks from the turntable, and as close to the roundhouse as trackage will permit. Five roads prefer sanding facilities at the coal chute. One road recommends that the coal chute be equipped with an automatic sprinkler system and with crusher and scales. One road reports the coal chute located about 200 feet from the ash pits; while it is desirable, according to two other roads, to have the ash pit adjacent to, but not immediately under, the coal chute in order that men from either one can help out at the other in rush periods and the fumes from wet ashes and the ashes themselves will not corrode the steel work of coal chute.

For a cold country one road recommends that the roundhouse, turntable, ash pit, etc., all be placed under one roof, with the coal chute close by, and incoming engines to be left by the crews before coming to the coal chute.

The problem of coal chute and ash pit organization depends materially on the amount of power handled, as well as the question of roundhouse organization and the character of repairs to be made; in other words, it is based on the size of the terminal and the business handled.

Five roads report a foreman in charge of the coal chute and ash pit, whose duties are to see that all engines are properly sanded, coal and water furnished, and fires cleaned. Four roads recommend roundhouse foreman's supervision of ash pit and coal

chute gang leaders, fire cleaners, ash shovelers, helpers, etc. There is not sufficient data available upon which to base a recommendation for a definite system of organization.

Regarding roundhouse operation as a whole—while only four roads replied on this subject, three agree that there has been a great deal of neglect in the proper design of roundhouses. Adequate equipment with as many labor-saving devices as possible will repay the expense of installation in a short time. Roundhouses should be equipped with proper ventilation to force out smoke and gases.

Eleven roads recommend coal stoves as the best method of drying sand, while six roads prefer steam coils. It is pointed out that drying by stove burns off organic matters and renders the sand more gritty.

A large majority of roads replying prefer the elevation of sand by compressed air, while a small number prefer the chain and bucket elevator operated by motor. Conveying sand to locomotives by gravity appears to be universal practice.

The recommended distance between the pilot and the outer wall of the roundhouse varies from 8 ft. to 15 ft, while the distance between the face of the coupler on the tender and the wall varies from 5 ft. to 10 ft. The distance from the locomotive to the side wall varies from 5 ft. to 10 ft. The ideal arrangement would provide sufficient space between the walls to permit the removal of the engine truck and both tender trucks at the same time, with the tank cut loose.

With reference to roundhouse door clearance, the replies cover doors which vary from 12 ft. 8 in. to 14 ft. in width, and from 14 ft. to 18 ft. in height. One road strongly recommends steel framed doors.

Steam heat is recommended by nine roads as the best method of heating roundhouses, while five prefer hot air and two roads prefer coal stoves. Others specify steam heat for small roundhouses and hot air for large roundhouses. The preference in location for steam heat is to place the coils in the pits, properly protected from above. It is essential that the coils set in from the side so that water drippings from thawing ice and snow on engine will not run on them. Eight out of nine roads recommending steam heat favor steam coils on the outer wall, while five roads report additional coils on the inner wall to whatever extent is permissible.

The vacuum return system of steam heat is preferred by the majority of roads, while some use exhaust steam from the air compressor and stationary engine.

Several of the roads recommending the hot air system for heating roundhouses do not heat the pits, but have outlets four feet from the floor with drop at alternate spaces between pits.

The problem of roundhouse heating depends materially upon climatic conditions first, and upon such matters as the availability of waste or exhaust steam. While the desirability for well-heated roundhouses is apparent to all, it is a local problem.

There is much difference of opinion on the question of machine tools for roundhouse work, and this subject depends very largely upon the amount of work to be taken care of. A number of roads recommend the installation of machine tools separate from, but attached to, the roundhouse, located as nearly centrally as possible.

The majority of roads recommend drop pits to take care of

engine truck and trailer wheels, in addition to the main drop pit. Several roads report the desirability of separate drop pits to handle tender truck wheels, while one road advises that a single pit is ample. A second road recommends a driving wheel pit for every six stalls and an engine trailer pit for every ten stalls. The Whiting hoist is mentioned by several roads for driving-wheel pits in large roundhouses.

The hydraulic drop pit jack appears to be favored by the majority, although a small number of roads prefer air jacks, because the telescopic feature requires less depth of pit. One road reports an electric crane for lifting wheels, while a second road specifies the Watson & Stillman hydraulic compressed air telescope jack.

Opinion is divided between concrete, creosoted block, brick, and mastic or asphalt composition for roundhouse flooring. The majority, however, recommend creosote blocks, with concrete second. The use of jacking blocks the full length of the pit is universally recommended.

Smoke jacks are reported as made of fireproof wood, sheet metal, asbestos and cast iron, opinions being about equally divided. The views as to the hood opening at bottom range from 8 ft. to 15 ft. in length. Several roads recommend the use of dampers on smoke jack.

The recommendations regarding handling material in roundhouses include a trolley track, swing crane, overhead traveling crane, electric truck and collapsible horses.

The majority of roads recommend that all stalls be equipped with hot water wash-out facilities, while several prefer only one-half of the stalls equipped. The general view is that the washing of locomotives with hot water is at all times desirable from the standpoint of saving in time, fuel, water and of most importance, reduction in fire box repairs. The majority of roads blow off boilers through a blow-off pipe leading from the engine to the atmosphere or tanks, which in some cases are connected with the sewer. Three roads recommend a pipe line from end to end of the engine house above the locomotive domes, with a connection at each pit, and outlets at both ends of the house. This system is used by one road to connect up with a cold water system to cool down boilers. This entire subject is of the most importance in connection with engine terminals.

As to roundhouse lighting, there is about an evenly divided preference for reflector lights on the walls and lights placed between pits. All, however, favor sufficient extension plugs on post for working in pits and fire boxes. In lighting outside grounds, all roads appear to favor flood lighting of sufficient power and proper height to afford a good light on points where needed.

Conclusions

Analysis of the replies indicates the widest divergence of opinion on nearly all subjects connected with roundhouse and engine terminals—this refers to design, equipment, maintenance and operation. It is natural that varying local conditions should develop different systems at engine terminals, and there is little opportunity for standardizing on the general layout of engine terminals. As a rule, there is no choice of location and the ground available is usually limited both in area and in relation to its surroundings. It is, therefore, apparent that the layout of each engine terminal is properly a separate problem—again, the entire problem is largely a function of the size of terminal, the power handled, the estimated expansion of future business, and similar questions.

The replies, however, indicate a decided trend in the last few years toward improvement in facilities in modern terminals, especially in heating, lighting, ventilating, tool equipment, boiler washing, cleaning fires, coaling and sanding.

There might be a desirability in standardizing roundhouse design as to general dimensions and structural features, that some progress may be made in the future toward the standardization of such equipment as roundhouse cranes, drop pits and washout systems; also in lighting, heating and ventilation.

The committee requested that it be continued.

The report was signed by C. E. Fuller (Chairman), Union Pacific; W. J. Tollerton, Chicago, Rock Island & Pacific; E. W. Smith, Pennsylvania; Joseph Chidley, New York Central; John Purcell, Atchison, Topeka & Santa Fe, and J. W. Small.

Discussion

C. E. Fuller (U. P.): This seems a simple subject, but when you take into consideration the requirements of terminals for dispatching engines on roads with from 3 to 200 locomotives leaving a day, you will see that the problem is quite a large one.

No conclusion can be offered at this time. The committee received such a limited number of replies and so many features were brought into the subject, that about the only thing we have agreed on was the tools, the roundhouse and smokejack. The balance is presented as matters of individual opinion. The report can only be considered as a progress report.

Mr. Tollerton: It is a most important subject in view of the remarks of Mr. Basford this morning. Engineering Section II has appointed a committee on Shops and Terminals, which will work with the committee of Mechanical Section III, and next year you will have a better and more detailed report on this subject. Of course, it is one that constantly changes and the standardization of terminals will be an impossible thing to accomplish unless we would stop all progress. But it is of great benefit to this Association to have in our records descriptions and details of adequate terminals for the proper and economic repairs to the equipment of both engines and cars, and to have these terminals laid out in such a manner that the repairs can be made promptly and with the least possible delay.

E. W. Pratt (C. & N. W.): I suggest that this committee should have given their opinion on the sequence of operations of locomotives approaching the roundhouse. I have noticed some locomotive terminal layouts recently where the ashpit was the first mechanism approached, and after that was the coal chute, and the water crane. I have heard individuals complain very bitterly in cold weather that it was so long between the time that the fire was knocked out of the locomotive, until the locomotive was placed in the roundhouse, and the distance so great that the locomotive arrived in the roundhouse leaking.

W. H. Sample (C. T.): The question which effects us very materially in Canada, where the climate is cold, is the question of cinder cars, the handling of cinders to the cars when they are wet and unloading them afterwards. At our terminals we have ample space, and we are undertaking an arrangement now whereby we can store the cinders during the winter months, and handle them in the spring after they are thawed out, and eliminate the use of cinder cars entirely.

H. M. Curry (N. P.): We have had difficulty in securing and maintaining the character of mechanics in our roundhouses that we require, particularly in the colder sections of the country.

We have had wonderful success with our hot water boiler washing plants. I hope to see the time when every terminal on our system will be equipped with a plant of that sort. We have both steam heated and hot air heated roundhouses. We have never secured the results from hot air heated roundhouses that we hoped for. At one of our large roundhouse points, the roundhouse was originally equipped with an electric trolley, with the idea of cleaning the fires in the roundhouse, the roof of the roundhouse is high and the stalls long. It was heated with hot air. We have a fairly good sized hot air plant, with quite a liberal radiation provided, but it was utterly impossible to heat that roundhouse with hot air until we provided a return duct from the roundhouse.

C. E. Fuller: If it is true that the locomotive is the most important factor in transportation, and if it is true that the hours out of service of the locomotive are excessive, I believe you will agree with me that the starting point, or the foundation for that condition, begins at the roundhouse or the terminal yard.

To dispatch engines quickly it is necessary that when an engine arrives home it is put in the roundhouse without delay, and not allowed to stand outdoors for three, four or five hours, waiting for room, either at the ash pit, the coaling station, or for trackage in the house.

It is also true that the number of times an engine receives general repairs, or the frequency with which an engine receives general repairs, depends to a large extent on the upkeep or lack of upkeep in the roundhouse. If a terminal yard is so situated that you cannot get an efficient terminal in it, the committee is not particularly concerned with it. What we want is the best that there is. I have felt that it

was not improper to impress upon your mind, that you give thought, and possibly a little more personal attention to the circulars received from the committees.

The fact cannot be denied that we are criticized for keeping engines at terminals an excessive length of time. Why are we doing it? Either we have not a competent force or our facilities are inadequate, and are not arranged for taking care of the volume of business. In other words, a nice terminal may be built to meet your summer conditions, but in the wintertime there is 10 or 20 per cent more power to put in the territory, and under these conditions many engines must stay outdoors, waiting to get into the house. Even though you are short in your force of men, if you can get the engine into the house promptly and have it immediately thawed out and ready for work, you can, as a rule, reduce the delay very much.

I think the subject is one of the most important before you, and it is up to the members of this association to give the benefit of their knowledge of what the railroads should have in the way of terminal facilities and terminal organiza-

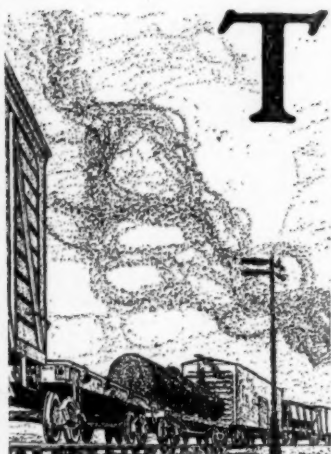
tion to this committee, so that it may present a report embodying the very best practice.

E. Wanamaker (C. R. B. & P.): It seems as though the turntable proposition is left out of the report entirely, and my experience leads me to believe that it is one of the most important elements in the roundhouse. I would be particularly interested to know what the recommendation would be for the operation of a turntable, especially in a cold climate, what source of power could be used, and what would be the best to apply.

If you go to many roundhouses you will find the steam supply is very inadequate because the boiler plant is not properly maintained, and many times the man or men engaged to make the steam heating equipment are not sufficiently intelligent or sufficiently well instructed, to co-operate, not only to secure capacity, but to secure safety. I think this is certainly one of the most important points we have to consider, if we are to cut down the time of engines in terminals.

A motion that the report be printed and made part of the proceedings was seconded and passed.

Report on Train Resistance and Tonnage Rating



THE SUBJECT OF EQUATED TONNAGE RATING was referred to the Committee on Subjects for investigation and report to be presented at the annual meeting.

The treatment of the subject of equated tonnage method was handled in the 1914 report under the heading of "Drawbar Pull Method" (see 1914 proceedings A. R. R. M. M. A., Table 3, pages 313 and 314), in which case the tons and cars were added until the number of cars correspond to the rating shown for the locomotive, also proceedings of 1916, pages 427 and 433.

This subject is also covered fully by the report to the American Railway Engineering Association, Bulletin No. 138, dated August, 1911, by M. H. Wickhorst, and the committee has been unable to develop any new phases on the subject of better methods of application.

The committee has not been able to assemble the data which has been collected in time for a complete report on this subject for this convention and the foregoing is submitted as a progress report.

The report is signed by O. P. Reese (Chairman), Pennsylvania; H. C. Manchester, D. L. & W.; C. E. Chambers, C. R. R. N. J.; Frank Zeleny, C., B. & Q.; Jos. Chidley, N. Y. C., and E. C. Schmidt, North American Company

Discussion

A. B. Appler (D. & H.): I would like to ask if the train resistance and tonnage rating committee has any record of tests to indicate the internal friction or resistance in pounds per ton in Mallet type locomotives at different speeds.

O. P. Reese: That subject has not been given consideration in connection with this report. The resistances so far considered have been of different weights and sizes of cars, and different types of cars of the same weight. The resistance as relating to the various types of locomotives has not been given further consideration on account of the work which was previously done. The committee did not have available any recent information on locomotive resistances, that is, the new types of locomotives.

A motion that the report of the committee be received, and printed, and the committee continued was seconded and carried. Adjournment.

Carnival Night a Big Success

LAST NIGHT'S SOCIETY EVENT on the Million Dollar Pier yielded only to the Grand Ball of the previous night in point of splendor and attendance. In the way of real pleasure, mixed with a liberal portion of real fun, it yielded nothing. Probably it will be remembered and talked about long after the event of Thursday night has been forgotten.

It was carnival night. Isn't that enough to say? The three thousand ladies and gentlemen who attended will answer, "yes." The orchestra was at its best. Given good music, a good floor and good partners, what more was to be desired.

The program consisted of 20 dances. During the intermissions between dances the members of the Entertainment Committee distributed vari-colored hats and caps, paper canes, whistles and gimcracks of many kinds.

In charge of the evening's carnival were: L. O. Cameron, chairman; Floyd Coffin, Horace Hager, Ellsworth Haring, R. J. Himmelright, T. J. Hudson, Jr., Langley Ingraham, W. W. Melcher, I. C. Rogers, S. W. Sargent, R. P. Townsend, W. M. Wilson and W. B. Wise.

W. P. Pressinger Passes Away

WHITFIELD P. PRESSINGER, vice-president of the Chicago Pneumatic Tool Company, did not survive the dangerous operation which he underwent at the Roosevelt Hospital, New York, Monday last. He passed away Thursday night. His many railway and railway supply friends throughout the country will sincerely mourn his loss.

Car Heating Decision

THE SUIT BROUGHT by the Vapor Car Heating Company against the Gold Car Heating & Lighting Company for alleged infringement of Vapor Patent No. 758,436 has been decided by the United States District Court for the Southern district of New York in favor of the Gold Car Heating & Lighting Company. By reason of this decision the Gold Car Heating & Lighting Company may continue to make and sell its vapor valves and its vapor system for use in heating railway cars (all pipes underneath car to be covered as heretofore), without infringing any of the patents of the Vapor Car Heating Company.

"Important News" For Foreign Consumption

AS AN INSTANCE of the "progressiveness" of foreign newspaper correspondents in the United States may be mentioned the following item which appeared on the wireless news bulletin of one of our Trans-Atlantic steamers:

"Washington, June 3. President Wilson came out yesterday with his last season's straw hat making his bow efficiently to summer in an automobile ride through the park."

Geo. H. Hazelton Dies

GEORGE H. HAZELTON, formerly division superintendent of motive power of the New York Central & Hudson River at Albany, died on Thursday night. Mr. Hazelton was in the service of the New York Central, or associated lines, for more than 53 years, starting on the Rome, Watertown & Ogdensburg. He was superintendent of motive power of that road when it was taken over by the New York Central, and was made division superintendent of motive power at Albany. During recent years he has been assigned to special duties, retiring last fall, when he was 70 years of age. After his retirement, however, he was called back into the service for special work.

N. I. T. League Advocates

General Rate Increase

MEMBERS OF THE EXECUTIVE COMMITTEE of the National Industrial Traffic League, the largest and most representative organization of shippers in the country, testified before the Interstate Commerce Commission at the rate hearing yesterday strongly urging a general advance in freight rates, the amount of which they were willing to leave to the commission under the provisions of the Transportation Act. They declared that the need for additional and better railroad service is paramount and that lack of service is costing shippers more than double the amount of the freight rate. They also expressed the opinion that it would be better to be too liberal with the railroads than not liberal enough.

Republican Platform on Railroading

THE platform of the Republican party adopted in its national convention in Chicago strongly endorses the new transportation act and claims credit for its enactment for the Republican majority in Congress. It condemns not only Government ownership and management of railroads, but also "employee operation," which is a direct blow at the Plum Plan. The plank on the railroad matter is as follows:

"We are opposed to Government ownership and operation or employee operation of the railroads. In view of the condition prevailing in the country, the expenditures of the last two years and the conclusions which may be fairly drawn from an observation of the transportation service, both for the present and future, can be furnished more certainly, economically and efficiently through private ownership and operation under proper regulation and control.

"There should be no speculative profit in rendering the service of transportation; but in order to do justice to the

capital already invested in railway enterprises to restore railway credit to induce future investments at a reasonable rate and to furnish enlarged facilities to meet the requirements of the constantly increasing development and distribution, a fair return upon actual value of the railway property used in transportation should be made reasonably sure, and at the same time to provide constant employment to those engaged in transportation service with fair hours and favorable working conditions at wages or compensation at least equal to those prevailing in similar lines of industry.

"We indorse the transportation act of 1920, enacted by the Republican Congress, as a most conservative legislative achievement."

Election of Executive

Committee Members

THE DISTRICT ELECTIONS for executive committee members will be held in the executive committee room, near the Secretary-Treasurer's office, this morning between 10 and 11.30.

The members to be elected are:

1st District—New England and Canada—One member to elect.

2nd District—New York, New Jersey—One member to elect.

4th District—Ohio, Indiana, Michigan—One member to elect.

5th District—Illinois—One member to elect.

7th District—Wisconsin, Minnesota, Louisiana and States West of Mississippi River—One member to elect.

Registration, American Railroad

Association, Sec. III, Mechanical

Appler, A. B., M. E., D. & H., Blenheim.
Baker, W. A., G. F., Western Railway, Alpernard.
Bell, J. Snowden, New York, Wiltshire.
Benett, W. H., M. M., Penn., Calvert.
Booth, C. W., M. M., N. Y., N. H. & H., Seaside.
Bosenbury, J. M., S. M. P., Ill. Trac., Traymore.
Bright, W. J., Ch. Clerk to Gen Mgr., B. & O.
Burkhard, A. A., Gen. For., N. Y. C., Arlington.
Burnham, W. D., Gen. For., B. & O.
Butler, T. L., M. M., Penn., Craig Hall.
Butt, F. W., Asst. Eng., N. Y. C.
Chaffin, H. B., M. M., Penn., Esplanade.
Cramer, C. B., M. M., Wash. Term. Co., Elberon.
Currie, H. A., Asst. Elec. Engr., N. Y. C.
Daley, J. H., D. M. M., N. Y., N. H. & H., Osborne.
Dambach, G. O., V. P. & G. M., Unity Rys., Sterling.
Deeter, D. H., M. M., P. & R.
Diven, J. B., M. M., Penn.
Dobson, F. L., M. M., Penn., Chalfonte.
Edmonds, Geo. S., S. M. P., S. S. Del & Hudson., Haddon Hall.
Edmondson, W. G., Asst. Eng. M. P., P. & R.
Eggleston, H. D., Fore. of Engines, P. & R.
Elmer, Wm., Supt. Middle Div., Penn., Chelsea.
Filskov, T., G. E. S., Raritan River, Princess.
Finegan, L., S. S., B. & O., Marlborough.
Flinn, R. H., M. M., Penn., Craig Hall.
Galloway, A. K., G. M. M., B. & O., Haddon Hall.
Gill, C. A., S. M. of E., B. & O., Ambassador.
Hadley, Frank Pres. G. M., Interborough R. Ty., Shelburne.
Halliwell, C. J., M. M., W. I. & S.
Haupt, H. H., A. E. M. P., Penn.
Haynes, T. F., Asst. Eng. M. P., Penn., Craig Hall.
Hines, J. P., M. M., B. & O., Ambassador.
Hoffman, George P., G. C. F., B. & O., Terminal.
Hopkins, J. W., M. M., Penn., Esplanade.
Johnston, W. D., Genl. M. M., B. & O., Traymore.
Knight, G. E., S. M. P. & S., Cuba R. R., Alamac.
Lambeth, G. L., Mobile & Ohio, Alamac.
Langton, G. H., M. M., Virginian, Strand.
Lightfoot, S. S., Equip. Eng., A. T. & S. F., Esplanade.
Lockwood, B. I., C. M., Pressed Steel Car Co., Chalfonte.
McAlpine, J. H., M. M., Can. Nat. Rys., Marlborough.
Maurer, W. R., Eng. of Equip. & Mch., N. Y., N. H. & H., Haddon Hall.
Moriarity, G. A., Mech. Supt., N. Y., N. H. & H., Shelburne.
Mullen, D. J., S. M. P., C. C. C. & St. L., Breakers.
Myers, H. E., M. M., Lehigh Valley R. R., Buffalo Div., Dennis.
Overdorff, C. A., M. M., Penn., Elberon.
Parker, William, Jr., Asst. Eng. of M. P., Penn., Elberon.
Pitt, W. R., Trav. Auditor, B. & O., Worthington.
Read, S. C., Asst. M. M., Penn.
Feid, C. H., M. M., N. Y., N. H. & H., Osborne.
Rogers, J. W., Asst. M. M., Penn.

Rusling, W. J., Penn.
 Schneider, G. A., M. M., W. J. & Seashore, Princess.
 Smith, J. A., V. P., Middletown & New York, 1515 Pacific Ave.
 Stell, Geo. J., Gen. For., Logan Div. Penn.
 Strunk, A. S., Foreman, P. L. V., Bluefield.
 Stuart, R. T., M. M., Raritan River, Princess.
 Tosh, A. C., Insp. of Trans., P. & R.
 Thomas, G. W., Traveling Car Insp., St. Louis-San Francisco, Traymore.
 Travers, O. H., Gen. For., Penn.
 Voelker, H. R., M. M., Penn., Craig Hall.
 Wallace, F. C., M. M., Erie, Dennis.
 Warnig, F. M., Eng. of Tests, Penn.
 Werst, C. W., Sterling.
 Whitman, E. B., M. M., Penn.
 Whyte, A., Asst. Secy. Loco. Dept., Rome Mfg. Co., Marlborough.
 Willson, L. M., M. M., W. J. & S.
 Winterrowd, W. H., C. M. E., C. P.
 Wright, J. D., Gen. For., B. & O., Arlington.

American Railroad Association, Sec. VI—Purchasing and Stores

At six o'clock Friday night the following members of Section VI had registered:

Alleman, C. W., G. S. K., P. & I. E. R. R., Elberon.
 Anderson, H. A., A. P. A., Penn., Marlborough.
 Beggs, J. H., P. A. C. & E. I. R., Traymore.
 Bichlmeir, G. W., P. A., Kan. City S. R. R., Ambassador.
 Blizzard, J. M., Storekeeper, W. J. & S.
 Bruckert, R. H., S. K., Kentucky & Indiana Term., Breakers.
 Buell, C. J., G. S. K., D. M. & N.
 Bushnell, F. A., P. A., G. N. R. R., Shelburne.
 Daniels, O. V., Asst. Genl. Skpr., P. R. R.
 Driscoll, F. E., Asst. P. A., Erie, Brighton.
 Dunn, W. C., Insp. of Mat., N. Y. C., Marlborough.
 Farrell, W. J., Asst. Secy. A. R. A., Marlborough.
 Fisher, N. B., Asst. P. A., P. & A. & McK., Traymore.
 Gowland, S. I., Asst. Genl. Storekeeper, Penn. R. R., Silverside.
 Hammond, F. S., Gen. Skpr., Pitts., Shawmut & Nor., Princess.
 Hill, J. P., Div. Skpr., P. R. R.
 Holzemer, J. F., P. A., T. & O. Cent., Chalfonte.
 John, F. E., A. G. S. K., B. & O., Haddon Hall.
 Kathan, John F., Jr., Div. Storekeeper, N. Y. Central, Beaumont.
 Keast, K. C., Asst. Forester, Penn.
 Kenzel, C. H., P. A., E. J. & E., Chelsea.
 Knight, H. L., Special Representative Purch. Dept., Western Maryland R. R., Monticello.
 Morris, Wm. W., Asst. to G. P. A., Penn.
 Nelson, R. M., P. A., C. & O. R. R., Marlborough.
 Peddle, C. R., P. A., Penn. Lines, S. W., Traymore.
 Shafer, S. W., Chief Clerk to P. A., C. R. of N. J.
 Suerrey, C. P., Supt. of Stores, Penn. Lines West, Silverside.
 Smith, Montgomery, P. A., Penn., Runnymede.
 Summerfield, D. W., Pur. Agent, Pittsburgh & W. Va. R. R.
 Towner, M. E., G. P. A., Western Maryland, Breakers.
 Walther, E. W., Asst. to Pur. Agt., B. & O., Haddon Hall.
 Wright, G. S., G. S. K., E. J. & E., Chelsea.

Special Guests

Anderson, J. B., Chief Clerk Gen. S. M. P., Penn., Runnymede.
 Armstrong, W. H., Draftsman, B. & O., Arlington.
 Armstrong, W. E. F., Resident Insp., B. & O.
 Barrett, Charles D., Asst. Eng. Tests, Penn.
 Bauman, W. J., Supervisor of Tools, B. & O., Schlitz.
 Bennett, H. R., Foreman, P. R. R.
 Berger, John, Spec. Eng., N. Y. C., Pennhurst.
 Bowes, W. E., Asst. M. M., Penn.
 Bracken, J. L., Asst. Elec. Eng., N. Y., N. H. & H.
 Burleigh, R. B., Kentucky.
 Busuioac, C., Dir. of Wks., State Rys. of Romania, Ambassador.
 Caldwell, Samuel, Foreman, Penn., Elwood.
 Churchill, A. A., M. M., J. C. Trac.
 Clemson, L. C., Retired For., Penn.
 Cooper, H. M., M. P. Insp., Penn., Regent.
 Coull, A., Gen. Eng. House Foreman, P. & R.
 Crawford, M. R., Foreman, C. R. of N. J., Louvan.
 Delcher, H. C., Inspector, B. & O.
 Donaldson, H. R., Asst. M. M., Penn.
 Easterly, H. R., Ch. Loco. Gen. Insp., Penn., Alamac.
 Filshov, A., Raritan River, Princess.
 Filshov, H., Asst. Eng., Raritan River, Princess.
 Finwaecher, E. H., Draftsman, B. & O., Arlington.
 Finnegan, J. A., Foreman, B. & O.
 Flowers, H. F., Amer. Elec. Ry. Assn., Traymore.
 Foertsch, Thos. A., R. F. E., P. & R.
 Galloway, L. E., G. F., B. & O., Channel.
 Gibson, W. L. G., Attorney, P. & L. E., Brighton.
 Ginnand, H. W., Buyer, Penn.
 Goddard, W. E., For., L. I.
 Goldsmith, H. A., Insp. Eng., Sterling.
 Goolsby, A. C., Adv. Mgr., C. & O., Traymore.
 Isaacs, J. C., For., B. & O., Bouvier.
 James, H. M. E., D. L. & W., Biltmore.
 Jamison, W. J., Draftsman, P. & R.
 Johnson, W. R., Ry. Dept., I. C. S., Haddon Hall.
 Jones, L. D., Insp. M. P., B. & O.
 Jones, M. W., Asst. Supt., P. & R.
 Kelly, C. W., Sec., National Railway Appliance.
 King, H. A., Draftsman, B. & O., Arlington.
 Kinney, Wm., For., A. C.
 Koebrich, F. W., For. M. P. Dept., Long Island.
 Kuhn, E. A., T. H. & B., 121 S. New Jersey.
 Leonhauser, H. A., Asst. S. R. S. United Elec. Rws.
 Lohman, Chas., R. H. Foreman, C. R. R. of N. J., Brady House.

McGee, W. A., M. E., N. Y. C., Strand.
 McNichold, C., Div. Frt. Agt., McK. Con., Galen Hall.
 Madden, T. B., Gen. Boiler Insp., Mo. Pac.
 Martin, John J., R. H. Foreman, C. R. of N. J., Brady House.
 Massey, G., Asst. Foreman, Central R. R. of N. J., Wellsboro.
 Minick, J. L., Asst. Eng., Penn.
 Moll, H. P., P. & R., Netherlands.
 Moll, R. H., P. & R., Netherlands.
 Morris, J. M., Asst. Traffic Mgr., McK. Con. & L. T., Galen Hall.
 Morrissey, Tom A., Clerk, L. V., Princess.
 Morton, R. C., Draftsman, B. & O., Arlington.
 Mow, Fred, Kansas City Terminal, Ambassador.
 Munroe, Martin, Eng., Romanian State Rys., Ambassador.
 Newberry, C., M. C. B., New Orleans Pub. Belt, Elberon.
 Nicholas, P. H., Asst. M. M., C. R. R. of N. J., Lyric.
 Norton, A. W., Equip. Pilot Eng., B. & O., Arlington.
 Parsons, D. R., Supt. Shop Schedules, B. & O.
 Pietsch, T. A., Supt. of Inspection, B. & O., Arlington.
 Powers, C. E., Spec. M. P. Insp., B. & O.
 Pratt, H. R., Chief Eng., Western Maryland.
 Price, Townson, 2nd Asst. Examiner, U. S. Patent Office, Kingston.
 Reuter, Sebastian, For. M. P. Dept., Long Island.
 Richards, Lewis, Foreman Engine House, P. & R., Bouvier.
 Rippey, W. S., Retired Clerk, Penn., 4401 Atlantic Ave.
 Robey, A. A., Asst. C. C., Southern, Osborne.
 Russell, Walter L., Eng. House For., P. & R.
 Ruttger, Fred W., For., L. I.
 Ryan, E. J., Welder Foreman, B. & O., Ambassador.
 Scheckard, J. W., Asst. Road Foreman of Engines, Phila. Div. Penn., Girard.
 Scheifele, John, Jr., R. F. E., P. & R., Norwood.
 Seddon, Edward, Gen. Mach. For., Lehigh Valley.
 Shearer, L. D., Supt. Tel., P. & R.
 Shelton, F. M., Supt. Loco. Sup., D. L. & W., Princess.
 Shugars, Geo. C., P. & R.
 Siegfried, M. A., Asst. Rd. For., C. R. R. of N. J.
 Simpson, G. R., Primary Examiner, Dept. of the Interior, Kingston.
 Sleeman, Wm. C., Car Eng., Birmingham South., Haddon Hall.
 Sleuker, C. A., For. Black, L. I., Glenmore.
 Smith, Russell M., Asst. R. F., Penn.
 Spence, C. H., Draftsman, B. & O., Craig Hall.
 Stewart, Robert, C. Repair, Penn.
 Stoffert, H. A., El. Eng., P. & R., Bouvier.
 Stiglmeier, A. F., Boiler Foreman, B. & O., Schlitz.
 Strong, James B., Pres., National Appliance Assn., Esplanade.
 Strunk, John, For. Boilermaker, A. C.
 Summerfield, John, P. W. V., Marlborough.
 Sykes, Louis, Shop Supt., Penn., Strand.
 Taylor, Grant W., Asst. to V. P., Southern.
 Thompson, F. V., Foreman Elec., Atlantic City.
 Tiley, Geo. E., Supt. Tank Car Equip., General Chemical Co.
 Tippet, M. W., Foreman, Washington Terminal, Elwood.
 Train, A. H., Spec. Eng., N. Y. C., Pennhurst.
 Turk, J. E., Supt., P. & R., Chalfonte.
 Van Gundy, C. P., Dbf. Chemist, B. & O., Shelburne.
 Wakely, G. B., Senior Draftsman, N. Y. C.
 Walsh, H. T., Supt. Weld. Dept., N. & N. S. & B., Ambassador.
 Walter, F. W., Draftsman, B. & O., Craig.
 Webb, T. H., T. F. S. A. L., Schlitz.
 Wang, Geo., Asst. Eng., W. M.
 Warner, J. W., Clk. Mech. Dept., Staten Island Rap. Trans., New Belmont.
 Weber, C. J., Foreman, B. & O., Dennis.
 Wells, George W., Director of Exhibits, Am. Elec. Ry. Assn., Traymore.
 Wheeler, H. B., Gen. For., B. & O.
 Whitsitt, W. B., Ch. Draftsman, B. & O., Arlington.
 Wilkinson, D. A., Supt. Tools, N. N. & B. D. D.
 Woley, L. W., Eng., I. C., Traymore.
 Woods, J. L., P. A., N. C. & St. L., Marlborough.
 Woodson, E. R., Secy., Ry. Acct. Office, So. Illinois Ave.
 Worden, W. E., Foreman Car Repairs, Southern-Monroe, Baltimore.
 Wright, G. V., Insp. Eng. Dept., N. Y. C.
 Wright, W. T., Chf. Cl. to S. M. P., N. Y. C., Chelsea.
 Wyman, William I., Ch. Cl., Patent Office, St. Charles.
 Yarbrough, W. C., Asst. Treas., A. C. L., St. Charles.
 Yost, T. William, M. P. & R. E. Dept., P. & R.
 Ziegler, C. J., Ch. Electrician, Florida East Coast, De Ville.

Swiss Railways in Good Shape

No matter from which country one enters Switzerland the contrast in railways and railway equipment is particularly noticeable. The Swiss railways are extremely well kept. The cars, locomotives, roadbed and every employee presents a clean and neat appearance. The employees, regardless of their position, are provided with uniforms of a character suitable to the position in which the men work. Throughout the winter it was a pleasure to ride on the Swiss roads and almost a hardship to ride on the roads of any of the adjoining countries. The cars were well heated and well lighted. The Swiss have suffered the same as every other European nation as regards the scarcity and high cost of fuel. It was no uncommon sight to see huge piles of wood at the engine terminal points which was used to a very large extent on locomotives. It has been this shortage of fuel that has pushed the electrification of the lines. Switzerland is determined to make itself independent of foreign nations for its fuel supply and has very intensive plans for electrification which it will take from 25 to 30 years for it to fulfill.

European Railway Observations

By Robert E. Thayer

European Editor, Railway Age

English Shop Men Repudiate Piece Work

Inspired by the successes of their fellow unionists, the shopmen of the English roads are starting an active campaign against the piece work and all forms of the bonus system. It is not that their rates have not been advanced, for they have already received liberal increases, but it is because of the fact that labor there, as here, is seeking to eliminate premiums being paid for good work. This to the English railways would be a severe blow, for there the piece work system has been highly developed and is long established. The management of the English railways can well look to the results occasioned by this step in the United States.

Belgium Is Recuperating Rapidly

The railway and industrial situation in Belgium is something that is attracting considerable attention all over Europe and, as far as it is known, in the United States. That nation is to be highly congratulated on the way it has met its reconstruction problems. The wages of labor have not been increased to the same extent as in France, yet the entire population has worked with a will that has done much to build up that country. The fact that the entire country was held in subjection for four long years by the German army is given as the reason for this wonderful "esprit de corps." The people are so glad to be rid of the domination of the Hun, that they appear to be impervious to all seditions and bolshevistic propaganda. It is an example which all patriotic citizens of any country could well emulate.

Force Feed Lubrication

A mechanical appliance for locomotives that has developed to a far greater extent in both England and the Continent than in this country is the force feed lubricator. The English railways have adopted this method of lubrication to a very large extent. It is estimated that about 7,000 British locomotives are so equipped. Practically all of the German locomotives are equipped with this system of lubrication and it is used to a very large extent on the railways in South America, India and Australia. At the present time, this system is used principally for the lubrication of cylinders, but it is being rapidly developed for the lubrication of driving boxes. The foreign railways claim that more perfect lubrication is obtained by the force feed system, that the lubricating oil is used with greater efficiency, that better regulation can be attained, that the delivery of oil to the rubbing surfaces is absolutely assured while the locomotive is in motion, and that less attention is required on the part of the engine crew. If force feed lubrication can be used successfully and efficiently on foreign railways, it can be used successfully and efficiently on American railways.

What Feed Water Heating Meant to Germany

The application of locomotive feed water heaters has become standard practice on the German railways. Every new locomotive built is provided with this appliance. All old locomotives with but few exceptions are to be so

equipped. Had it not been for the fact that the locomotives of Germany were equipped with this fuel saving and capacity increasing device they would not, in the words of the chief mechanical engineer of the Prussian-Hessen System, have been able to have met the transportation requirements as well as they have. The feed water heater not only saves coal but increases the capacity of the locomotive and with 50 per cent of its locomotives out of service for repairs this was a tremendously important factor to the German roads. Germany began using feed water heaters eight or nine years ago, and with the price of fuel increased by some 15 per cent, it is reaping a great benefit now. It is claimed that at present prices the cost of applying a feed water heater to a locomotive is more than met within a year after its application.

Encourage Foreign Visitors to Study Our Methods

Many foreign railway men have come to the United States for the purpose of studying our methods and the impressions they have experienced has depended to a great extent upon the reception and courtesies offered them by the railway men here. In one instance, a man came away from a large shop which we consider one of the best railway shops in the United States with a decidedly wrong impression simply because of the manner in which he was treated. His request for permission to view the shops was met in a most disinterested way and after being kept waiting for some time he was turned over to a young man who was entirely unfamiliar with the interesting details of the shop's work. As a result, it was not possible for him to obtain a correct idea of the work performed by that shop and, on his return home, he classified that shop as one of the worst he had seen in the United States. While these things do not have any direct effect on the railways themselves, except in the matter of reputation, they do have a serious effect upon the business of the United States and indirectly, of course, on the business of the railways. It is, therefore, important that every facility should be granted these men who often come great distances to learn about American methods.

Reports from Roumania

As in the case of almost every other European nation Roumania is suffering greatly from the fact that its railways are not in very good operating condition. Reports coming from that country indicate that the locomotive situation is the limiting factor. In addition to this Roumania has acquired considerably increased mileage, which further complicates the situation. It has been stated that only about 35 per cent of its locomotives are in operation. The labor situation there is very serious and is accountable to a very large extent for the poor locomotive situation. It has come to such a point that when the large industries call for locomotives with which to move their freight they are told by the government that if they will undertake to repair some of those out of service they will be given the use of them. Roumania had about 1,000 locomotives before the war and regardless of the fact that it has now 2,000, acquired from various countries with which it was at war, it is stated that there is a need for a total of 4,000 locomotives. In Roumania itself labor is not inclined to work hard enough to produce them and Roumania lacks money and credit with which to buy them from other nations. A recent press dispatch to the effect that the Baldwin Locomotive Works contracted to provide 50 locomotives, payment for which was taken in oil concessions, is indicative of the manner in which business is done there.

The Man Who Saw

The Blind Man's Mail Bag

Several of the friends and associates of The Man Who Saw have advised that he is missing his vocation—that he doesn't see at all, because he was unable to witness the fall of the airplane in the ocean and other things.

The Man invokes the indulgence of his friends to explain that he is very busy answering protests to Hum Dinger's Prune Plan, circular letters and other missives.

For fear that he will overlook the mention of things interesting to some of the friends, he respectfully requests that they advise him through the Mail Bag on his desk. He is here to serve, but only has two eyes which he nearly wore out on his trip to South America.

The Vacant Chair

The man in his rounds kept an eye out for the old friends, and as he approached the booth with the castings in it, way out in the right-hand corner of the pier, his heart warmed in friendly anticipation of the pat on the back for one of the bright spots whom he had known for years in the trade.

But the friend had gone in the Man's absence and the vacant chair bore mute testimony to the fact that he had embarked on the greatest trip of all to the land from which no traveler returns.

If the Man, but one of the hundreds who affectionately remember you could send a message to the spirit world, it would bear this inscription:

"You're gone, but not forgotten, Charlie."

They'll Need More Cars All Right!

"I'll show you an economy of 30 per cent," said the effervescent one who had managed to get in through a window behind the chief clerk's desk.

The "old man's" eyes twinkled over his glasses as he reached in the drawer of his desk and pulled out a memorandum.

"This is a list of the economies that have been offered me by various good fellows in the last two weeks," said the S. M. P. "We'll add your promise of 30 per cent"—and he added it up; it totaled about 429 per cent!

"That looks promising, doesn't it?" he asked the hopeful one whose heart was in his mouth at the prospect of an order. "You know," continued the "old man," "if we adopt all these devices, we will have to add an extra car to haul the coal they save!"

The "Biggest As Is"

The Man followed the two colored gentlemen to observe, if possible, the dark slant on things mechanical in the miles of cheerful booths strung along the pier. They missed nothing and their unconcealed admiration testified that the confident exhibitors hadn't wasted their enthusiasm—even on a waiter.

They paused in awe to get a closer look at the photograph of the latest Mallet which adorned the booth of the locomotive builder.

"Sam, what kind of a injine am dat?"

"Yo' sho is a ignorance," answered Sam with a look of superiority, "Dat am a millenium."

"An what am a mineliym?" eagerly asked the short

one, not at all embarrassed by his inability to pronounce the word.

"An you don't even know what a millenium am?" criticised the superior one. "Why a millenium am de same thing as a centential only it has mo' legs." The little one merely acknowledged this outburst of wisdom with a nod of his head. He had "gotten an earful."

The "Try Weakly"

"How often do you run to Poseyville?" inquired the supply man of the agent at the junction one Monday morning.

"Tri-weekly," came the quick response from the busy one behind the grating, "Mondays, Wednesdays and Saturdays."

"Thanks," said the prospective patron, "give me a round-trip ticket." He stuck the ticket in his pocket and went outside to "look 'em over."

The modernizer sniffed at the array they called a train, standing at the platform, and he wondered whether it could make the run.

"Say," he accosted the busy one, as he emerged from his cage with a lot of mussed-up papers and a worried look, "how do you spell 'try'?"

"T-r-i," answered the official.

"Oh!" said the economizer. "Well, how do you spell weakly then?"

"W-E-E-K-L-Y," spelled the official, "say, don't you know how to spell?" he added with a sneer!

Standing Up for Argentina

The Man who Saw that there was little use in waiting for the apparently satisfied old lady to remove the three valises, the hat box, the blanket roll, an immense bouquet of flowers, the box of lunch, the umbrella, and the cage with the tired canary in it from his seat, ventured to invite two Argentine gentlemen to the diner for a glass of beer. They accepted and the thirsty parade of dusty throats started for the rear.

The Man, being thirstier than the rest and disregarding the customs of the country—true to the manners of his race—got there first.

The diner was full. At least it appeared to be. Many of the table occupants were asleep; the balance were stalling along on unfinished glasses of beer and the arrivals wondered where they could "head in." Somewhat out of patience, and thirstier at the prospect of disappointment, The Man decided to fling a bit of sarcasm at the proprietor of the alleged rolling oasis who sat in his cashier's cage, apparently happy in the thought that he had a cage to sit in.

"Excuse me, Senor," he ventured, "is this a dining car or a sleeping car?"

"Take your choice, gentlemen, we are trying to please all of our patrons here."

The trio gave up hopes and with tongues as dry as bath towels retreated forward.

The old lady in the meantime had taken advantage of the gentlemen's absence to transfer two of the valises, the hat box and the blanket roll to the vacant seat and sat unconcerned with the tired birdie and the rest of the house furnishings by her side.

Thus does this tale relate in a single instance that which is true of trains in the Argentine—crowded to the guards—apparently the only restrictions on the amount of hand baggage being the number of bundles which two or three servants could successfully push through the door, and frequently the windows. We aren't the only ones short of cars.

Conventionalities

Tom R. Brown, formerly with the Westinghouse Air Brake Company, spent a short time on the pier Friday afternoon. He is now vice-president and general manager of the Hollis Tractor Company of Pittsburgh.

T. A. Foque, general mechanical superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, was able to attend the convention this week, but the demands of business will render it impossible for him to be here next week.

K. M. Hamilton of The Bettendorf Company is attending the convention after establishing a Chicago office in the McCormick Building. This company discontinued its offices in that city during the war.

John J. Nicholson, president, Murphy Varnish Company, is here with a full set of golf sticks looking for trouble. He has with him a quartet of caddies consisting of C. M. Baker, F. O. Brazier, J. K. Milligan and W. D. Horton.

B. E. D. Stafford, of the Flannery Bolt Company—everybody's friend and a friend of everybody—is not here this year, and we are sorry. "Staf" has been sick for a few weeks and is now making a job of getting well on his country place in South Jersey.

Frank A. Morrison, of the Mason Regulator Company, returned from a trip through England, Belgium and France on the Adriatic, arriving on Saturday, May 26. Mr. Morrison has arrived at Atlantic City attended by his wife and two-year-old daughter.

H. S. Covey, secretary of the Cleveland Pneumatic Tool Company, might well be termed a specialist in preparing exhibits, as he has arranged every exhibit for his company during the past 20 years and prior to that arranged exhibits in other fields for 10 years.

Ask "Scotty Airbrake" Campbell to tell you the story of his friend who made a trip abroad recently on an English liner (of course), who the morning after the night before after passing the three-mile limit asked the steward who paid the taxicab fare to bring him home.

Many have wondered and many have asked the *Daily* as to the total number of people taking part in the Grand March of the ball on the pier Thursday night. According to the entertainment committee there were 32 lines of marching people with 32 ladies and gentlemen in each line, a total of 1,024.

M. A. Kinney, superintendent motive power, Hocking Valley, is justified in taking considerable pride in the fact that his road stands at the top of the list in trainloading. He is enthusiastic about the performance of the Santa Fe locomotives which his company recently purchased from the Lehigh Valley.

Beg your pardon! In the issue of the *Daily*, June 9, among the list of exhibitors the names of Frederick A.

Gale and H. L. Hilleary were given as representing the Locomotive Terminal Equipment Association. This was a mistake. Messrs. Gale and Hilleary tell us they do not represent this association.

J. E. Fairbanks, general secretary of the American Railroad Association, is accompanied to the convention by Mrs. Fairbanks. With all the meetings of the committees and sections of the American Railroad Association which are being held at the Traymore at Atlantic City, Mr. Fairbanks is a very busy man.

Miss Lavinia Morrison, daughter of Frank A. Morrison, was married to William F. Wright, vice-president of the Wright Manufacturing Company, of Lisbon, Ohio. Monday, June 7, at the Morrison home at Boston, Mass. Miss Morrison attended this convention last year and met Mr. Wright for the first time then. The bride and groom are including Atlantic City in the bridal trip itinerary.

Mrs. W. T. Tyler, wife of the vice-president of the Northern Pacific and former director of operation of the Railroad Administration, arrived yesterday, and is the guest of Mr. and Mrs. W. E. Sharp. The Tylers' son, Harold, who is known to many of the convention visitors and who served in the navy during the war, has entered the automobile business, and is vice-president and general manager of the Lafayette Motor Car Company at St. Louis.

A. W. Lord, of the Q. & T. L. Railroad, who is attending the conventions, believes that he is the oldest railway man in point of active service here. He began firing a locomotive in 1850, seventy years ago, and has been railroading ever since. He is now 87 years old. A record of continuous work of seventy years is one that few men have exceeded. The Q. & T. L. is a small road at Hancock, Mich., which is owned by the Quincy Mining Company.

Jim Morris, master mechanic of the Pennsylvania at Verona, Pa., who is attending the convention, served as first lieutenant and later as captain of the 35th Engineers abroad. He was located with the American commission at Coblenz after the armistice to receive the German equipment which was turned over to the Allies. Mr. Morris was in charge of the committee delegated to inspect and pass on the cars which the Germans handed over to the Allies.

The grand march in the ball room is an established institution, but John Purcell, of the Santa Fe, is responsible for the introduction of a grand march through the exhibit spaces. Instead of waiting for written reports after the convention Mr. Purcell is making a tour of the exhibits with the other mechanical officials of the Santa Fe and getting their opinions of the devices right on the ground.

Major Azel Ames, of the Kerite Company, is nursing a crippled hand acquired by trying to imitate the performances of his own youth. He participated in a baseball game a short time ago at the River Sea Club on the occasion of a celebration of the 25th anniversary of the graduation of his class from the Massachusetts Institute of Technology, and got his hand injured by thinking he could play baseball as he could 25 years ago.

H. M. Curry, mechanical superintendent of the Northern Pacific, is accompanied to the convention by Mrs. Curry. The Northern Pacific is making a splendid record as to attendance at the convention this year. Mr. Curry has brought with him all of his master mechanics, in addition to other members of his general staff.

Since the working of cranes in shops has so frequently been in the hands of women since the war, it is interesting to note that the first woman demonstrator to attend these meetings should be here in the capacity of a crane operator. The Chesapeake Iron Works, of Baltimore, brought Miss Florence C. Shaw, who has been handling a crane in the Baltimore shop, as one of the most expert and fittest to handle the 10-ton crane shown in its exhibit.

E. S. Wortham, of the Scullin Steel Company, has come to the conventions with an almost entirely new wardrobe. This is not merely because Mr. Wortham likes new clothes, either—although he does. He and Mrs. Wortham were living at the Glen View Country Club in Chicago when, on May 29th, the club house caught fire and burned to the ground. Mr. Wortham happened to be at the club and succeeded in saving a good many of his effects, but a large part of them were destroyed.

He who suspects the advisability of a trip to Mexico in these troublous times should consult Thomas Smith, who served the Santa Fe for 16 years and was subsequently master mechanic on the Mexican Central as well as the Tehuantepec National Railways in Mexico. Mr. Smith can be found at the booth of the Q. & C. Company, where he extends an invitation to his old friends to come around and bid him a last farewell before he again enters the disturbed realm of the bandit.

C. C. Higgins, superintendent motive power of the St. Louis-San Francisco, brings very encouraging reports regarding the present business and the business prospects of his railroad. The problem of the 'Frisco, like that of most of the roads, is not that of getting enough business but that of providing facilities with which to handle the business already available. Like most of the southwestern lines, the 'Frisco especially needs a very large advance in rates. With a substantial advance in rates Mr. Higgins looks forward to the time when the 'Frisco will be a first-class property, not only physically, but financially.

Walter Smith of the Pyle-National Company, who went abroad as a first lieutenant of the 49th Engineers in June, 1917, is here at his first convention since his return to this country. Mr. Smith has some interesting tales to tell of his experiences abroad. He was stationed at Coblenz as a representative of the American commission to receive the German equipment which was turned over to the Allies under the terms of the armistice. His particular work appertained to locomotives. He says that more than half of the locomotives submitted by the Germans were rejected. The Germans were supposed to turn over 1,000 locomotives at the rate of 15 per day, but as a general rule they delivered only five or ten. As a result of the delay in delivering this equipment they were penalized by being required to turn over many more than the original thousand.

George S. Edmonds, superintendent motive power of the Delaware & Hudson, who succeeded the late J. H.

Manning, has been eminently successful in keeping in intimate touch with his men. Until his promotion he was in charge of the Watervliet shops. When a large number of the men left the shop to go into service overseas he encouraged the formation of an "over here" association. This organization included all of the men in the service at Watervliet and its purpose was to keep in close touch with the boys "over there" and see that they were furnished with encouragement and comforts. After the boys returned from service the organization was changed to a "carry on" association. Its purpose is to keep in touch with all of the men at Watervliet and see that any who are ill or in need are given good cheer and such assistance as they may need. This organization is an exceedingly strong factor in promoting good fellowship among the officers and employees.

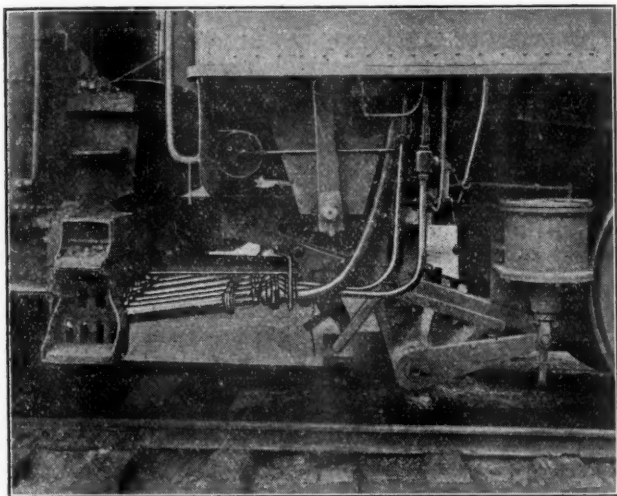
Officers of the Rock Island who are attending the convention met near the entrance of the pier at 2.30 o'clock yesterday afternoon and, under the leadership of W. J. Tollerton, general mechanical superintendent and chairman of the A. R. A., Mechanical Section, spent the afternoon visiting the exhibits in a body. The party included: S. W. Mullinix, superintendent of shops, Silvis, Ill.; L. A. Richardson, district mechanical superintendent, Des Moines; W. J. O'Neill, district mechanical superintendent, El Reno, Okla.; George S. Goodwin, mechanical engineer; E. Wanamaker, electrical engineer; J. H. Milton, superintendent car department; W. J. Hartman, general inspector; R. S. Mennie, engineer of shop improvements, Chicago; A. R. Ruiter, master mechanic, El Reno, Okla.; Bert H. Smith, master mechanic, Fairbury, Neb.; W. B. Embury, master mechanic, Armourdale, Kan.; J. M. Kerwin, master mechanic, Goodland, Kan.; W. F. Fitzgerald, master mechanic, Trenton, Mo.; J. McBrien, district car inspector. It is expected that a number of additional officers of the Rock Island will be here for the convention next week.

Hugh M. Wilson, formerly president of the Wilson Company, which until 1908 published the *Railway Age*, is one of the men well known to the convention crowd who have died since the conventions were held last year. He passed away last September. Mr. Wilson was for many years one of the men who were most active in connection with the conventions and exhibits. He was in direct charge of the publication of the *Daily* for a long time and was at one time secretary of the Railway Supply Manufacturers' Association. After the Wilson Company sold the *Railway Age* to the Railroad Gazette, Inc.,—now the Simmons-Boardman Publishing Company—in May, 1908, Mr. Wilson temporarily retired and made a trip to Europe. On his return he became vice-president of the Barney & Smith Car Company. Later he became vice-president of the McGraw-Hill Publishing Company. After he had stayed there for a few years his health broke down and he was obliged to take a long rest. He seemed to have almost completely recovered, but a short time after he returned to active work he was struck by an automobile near his home at Scarsdale, N. Y., and severely injured. His health was so destroyed as a result that he retired from active business, but in 1918 he participated energetically in the government's campaign to sell Liberty bonds. His death came very suddenly. Mr. Wilson was one of the most popular men who ever attended the conventions and when he retired from the *Railway Age* in 1908 he was given a dinner at Atlantic City by his friends in the railroad and the railroad supply business, which was a remarkable tribute to him, as well as one of the most interesting social events that ever occurred in connection with the conventions.

New Devices Among the Exhibits

Engine and Tender Line Couplings

AUTO-TITE flexible pipe joints and traverse expansion joints, in combination either with or without a rotary coupling, compose the Auto-Tite flexible expansion couplings for engine and tender lines manufactured by the International Couplers Company, Pittsburgh, Pa. The rotary coupling is designed to couple a pipe and a single expansion joint, or may be used to couple two expansion joints as desired. A quarter turn,



Auto-Tite Flexible Expansion Couplings Applied to Locomotive

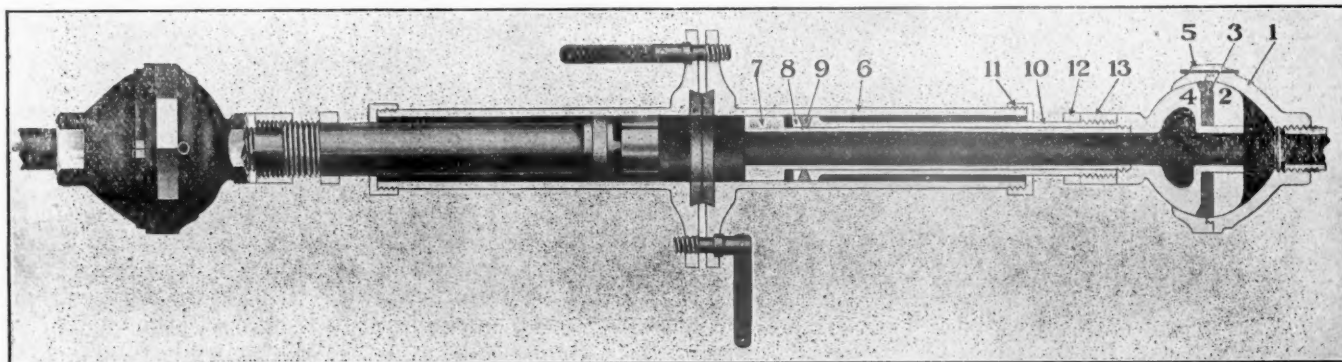
only, is necessary to make the coupling. Joints of this type were put into service on air brake and signal lines on the Western Maryland July 17, 1916, and when taken out of service January 28, 1919, both joints were tight and apparently good for further service on the same gaskets. The gaskets were not renewed during the two and a half years of operation and the joints were with-

subjected. The flexible expansion coupling, however, on the air signal line was in operation when the coaches returned to Baltimore with the air pressure on, as evidenced by the fact that this coupling was adjusted in the line back of the cut-out valve. The trainmen of the Western Maryland said that no difficulty had been experienced with the signal air. The maintenance of both joints consisted only in the use of a little oil, the cost of which probably did not exceed a few cents, being the total upkeep for the two and a half year period.

While the couplings may be used to advantage on passenger cars used exclusively on the home road, they are mentioned particularly in connection with engine and tender service because of the fact that it is not so essential to use the hose connectors thereon, for they require to be disconnected less frequently. The advantage of Auto-Tite couplings over hose may be plainly recognized in view of the above, and in addition, there is less air friction in a straight line coupling connection than in an abrupt, tortuous passage having two or three right angle turns.

Referring to the cross sectional view, the socket cup 1 and socket nut 5 form a continuous wall on spherical lines. The two members are tightened on registering marks and a cotter key thrust through registering bores in each member to keep them from working loose. The follower 2 has a sliding engagement with the sleeve of the sleeve hemisphere 4, and under fluid pressure acts as a piston head, compressing the gasket 3 between the planes and throwing it outward on the socket wall, all force tending to feed it tightly to a single feather edge at the juncture of the spherical lines of the ball and socket. Thus fluid pressure seeking to escape confines itself by its own pressure.

The outer circumferences of the metallic plunger 7, automatic follower 8, and manual follower 10, have a sliding engagement with the inner walls of the cylinder 6. From the inner circumferences the automatic follower and manual follower slidingly engage the plunger



Cross Section of Straight Line Coupling for Engine and Tender Lines

out attention or oil during a year and a half of this period, as the cars were away on foreign roads.

In the case of the air brake, the joint was detached from the train line when the cars returned to Baltimore, nevertheless, by reason of its adjustment on a tributary line, it was receiving every impact and expansion to which the springs of the draft gear were

stem. The automatic follower has spacing lugs spacing it apart from the plunger, forming a pressure chamber. The cylinder cap 11 is screwed on the end of the cylinder, forming a retainer or keeper to prevent detachment of the plunger and assembled members. Reverse nut 12 normally covers all threads of the manual follower, and in the operation of adjustment or tightening

the gasket is reversed against the abutment shoulder 13. The plunger is fitted with canals admitting pressure into the pressure chamber to operate the automatic follower. The automatic follower and the manual follower, providing outwardly flared opposing bevels, engage corresponding bevels of the gasket.

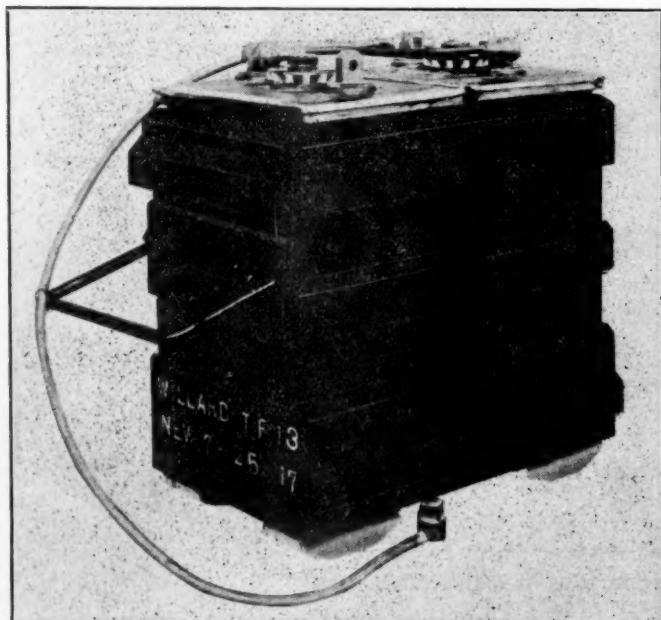
Under the act of compression, cohesion of the gasket to the cylinder walls tends to draw the gasket material tightly to a single feather edge at the juncture of the bevel of the automatic follower with the cylinder wall; while under the act of expansion, cohesion of the gasket to the cylinder wall tends to draw the gasket material to a single feather edge at the juncture of the bevel of the manual follower with the cylinder wall. Three tightening provisions are thus obtained, two of which are automatic, the remaining one being manual. The manual follower is operated by screwing it against the gasket which is molded in the form of a beveled sleeve.

It is proposed to manufacture the Auto-Tite flexible expansion couplings in standard sizes to replace signal, air brake, steam and water hose.

Combination Storage Battery

A COMBINATION STORAGE BATTERY designed during the war when lead costs were high, is being exhibited by the Willard Storage Battery Company, Cleveland, Ohio. This battery is of exceptionally light weight, being 30 per cent lighter than the straight Plante battery of the same capacity manufactured by the Willard Company. A proportionately smaller space, therefore, is required.

The negative battery plates are of bi-plane construction, the leaves on either side being cut to the center of the plate at right angles to each other. This type of negative plate has been used for ten years in railway work



Willard Combination Storage Battery

on a few sets of batteries and for three years on a large number of batteries. The estimated life of the plate is 15 to 20 years.

The positive plates are of the pasted type, made of the same material as the Willard automobile starting battery plates except that they are considerably thicker. The

battery has hard rubber covers and porcelain vent plugs. It is assembled either in rubber jars or lead linings. Rubber jars are exhibited which are made to the following specifications: 15 per cent elongation, 5,000 lb. per sq. in. tensile strength. The battery is made in capacities of 300 and 400 ampere hours.

Carborundum Refractories

THE EXHIBIT of the Carborundum Company, Niagara Falls, N. Y., this year includes a distinctly new line of carborundum products known as carborundum refractories. Carborundum refractories are made in four regular grades in addition to which special mixtures are utilized in the production of carborundum saggars. The four regular grades of Carborundum refractories are known as Carbofrax A, B and C, and Refrax. All of the standard shapes in which fire clay or silica brick are made can be produced in any of the grades, in addition to which practically any special shape, including tile, muffles and saggars, can be made in any of the three Carbofrax grades.

The carborundum used in the manufacture of carborundum refractories is in the purest form obtainable. Refractories made in any of the three Carbofrax grades are composed of over 90 per cent of pure carborundum to which small percentages of exceedingly high refractory materials are added to facilitate binding. The high refractivity of carborundum is, therefore, maintained in carborundum refractories, and due to the fact that carborundum cannot be melted, and is destroyed only by decomposition at temperatures over 4,000 deg. F., it is also impossible to actually melt Carbofrax brick or special shapes. Their exceedingly low co-efficient of expansion and high thermal conductivity reduces the spalling of these refractories to a minimum, and rapid change of temperature has little effect upon them. Their resistance to abrasion is also exceedingly great, as they are composed of a substance which is one of the hardest materials known. In furnace construction required to transit heat, such as muffle walls, etc., their value is indisputable due to their exceedingly high thermal conductivity which has been shown to be at least seven times that of the average fireclay brick.

The Refrax brick has the same general characteristics as the Carbofrax, but in the production of this brick absolutely no binding material is used. Refrax brick, therefore contains 100 per cent carborundum and the bonding of the individual grains of carborundum into the form of a brick is made possible by the fact that the growth of carborundum crystals is accompanied by what is known as twinning. These brick are produced in an electric furnace which is run at a temperature sufficient to produce carborundum, which is approximately 4,000 deg. F. Refrax brick is used for the more extreme temperature conditions, but as a general rule any one of the three Carbofrax grades will meet all ordinary high temperature conditions satisfactorily.

The principal uses for carborundum refractories as developed up to date have been in the construction of boiler furnaces, water gas generators, carbonizing retorts, heat treating and forging furnaces, all types of oil burning furnaces, pottery kilns, tunnel kilns, rotary kilns, electric furnace construction, muffle furnaces, saggars, etc.

Refractory Cements

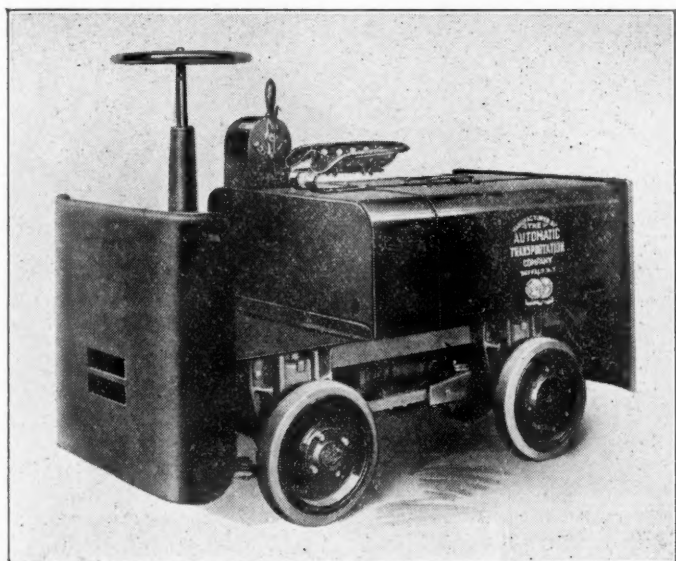
In addition to the regular line of made-up refractories, the Carborundum Company has produced a complete

line of high grade refractory cements. It has not been found possible to produce a refractory cement which will cover all conditions, and consequently ten special cements have been developed and these have been found to cover the field of requirements completely. These cements are of the highest value in the construction and maintenance of all types of high temperature furnaces. They are composed almost entirely of carborundum, and, therefore, possess its remarkable refractory properties. Used as a mortar or cement in laying up ordinary fire brick they will greatly prolong the life of furnace construction, and as a patching material they have given remarkable results. Carborundum cements should always be used in laying up Carbofrax or Refrax brick.

Tractors and Trailers

A NEW HEAVY AND EXTRA POWERFUL TYPE of electric tractor and a steel underframe trailer are exhibited by the Transportation Engineering Corporation, New York. They are manufactured by the Automatic Transportation Company, Buffalo, N. Y.

The tractor, which is known as Automatic Type M, is designed to meet the demand for a heavy duty tractor and is recommended for service in railroad shops and passenger stations. It is equipped with heavy cast steel bumper plates on both ends to facilitate the pushing of trailers and to provide extra protection to the machine

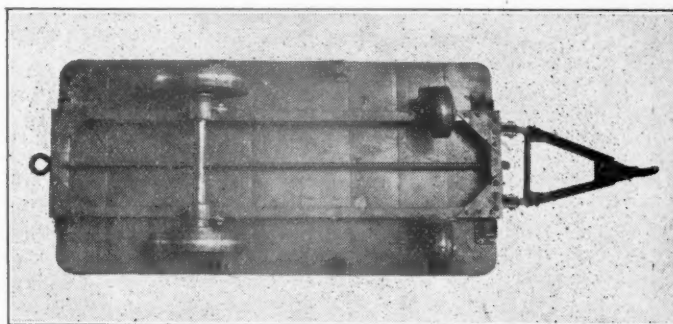


Type M "Automatic" Tractor

and the operator. A $3\frac{1}{2}$ hp., 1700 r.p.m. motor suspended on springs drives the tractor through a single reduction worm and wheel. All power transmitting parts are mounted in an oil-tight, dust-proof housing. This tractor may be equipped with either a 42 cell, A-8 Edison battery or with a 24 cell, M V Y Exide Ironclad battery.

The controller is of the metal drum type and provides three speeds forward and three reverse with a maximum speed of from 5 to 6 miles an hour. The normal draw bar pull is 800 lb. while the ultimate is 2,000 lb. The total weight of the tractor without the battery is 2,420 lb. It is made with either two- or four-wheel drive, two- or four-wheel steer and with sixteen- or twenty-inch rubber tired wheels.

The trailer is of the steel underframe, caster type. The steel underframe is applied to the trailer construction for the same reasons which have led railroad mechanical men to adopt the steel underframe in passenger and freight car construction. This trailer is, therefore, adapted to the severe service met with in railroad shops and terminals. Another distinctive feature of the Automatic trailer is the special heavy duty caster with which it is equipped. This caster is not only generously proportioned in order to withstand severe shocks under heavy load, but it is provided with both roller side thrust and

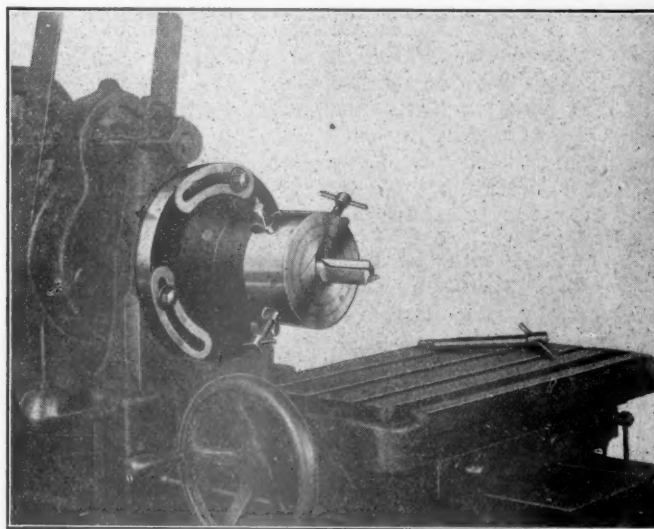


Bottom View of "Automatic" Steel Under-Frame Trailer

ball vertical thrust bearings insuring practically frictionless operation. The rear axle is also equipped with grease packed roller bearings. The trailer is provided with a special built up coupler hook, so designed and assembled that important parts such as hook and hinge castings can easily be replaced when necessary. The weight of the trailer without end gates is approximately 500 lb. and the platform is 16 in. from the floor.

Square Hole Drilling Attachment

A PRACTICAL DEVICE for drilling square holes is being exhibited by the Fairbanks Company, New York, at Spaces 324-326. This attachment, which is based on the well-known principles of the Cardan circles, can be easily and quickly attached to any milling machine or drill press.

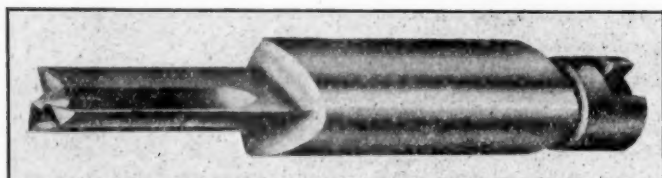


Radbore Head for Drilling Square Holes

The body of the drill has the form of a spherical triangle, which will always touch four

sides of a circumscribed square; and, as the triangle is turned, the corners of the triangle are moved in a rectangular path following the sides of the square. The cutting part of the tools is like that of an end mill, and its action is similar, except for the rectangular displacement.

The drill will cut a square hole with rounded corners, the radius of the fillet being one-eighth the size of the hole. If desired, a drill with a special shank can be used to cut square holes with sharp corners. To make a hole with sharp corners the shank of the drill is much larger than the cutting part, and one of the corners of the



Drill Used with Radbore Head

shank is rounded so as to permit the adjacent cutting edges of the drill to enter into the corner of the square holes. The other two cutting edges of the tool serve merely to rough out the hole while the finishing cut is made by the point which lies adjacent to the rounded edge of the shank.

The Radbore attachment not only drills square holes, but bores a blind hole with a flat, square bottom. The cutters are so designed that there is no material in the bottom of the hole which is not removed by the cutting edges. Therefore, finished blind holes can be obtained in one operation.

Drum-Contactor Controllers for D. C. Motors

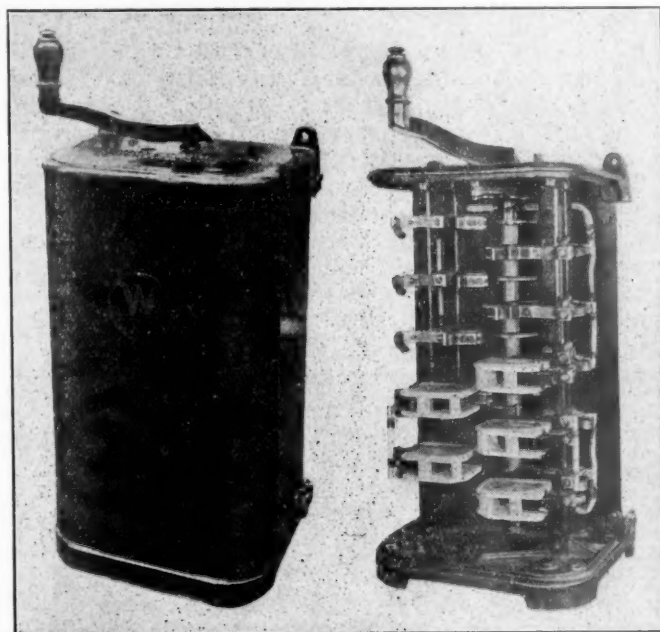
A NEW TYPE of manually operated, drum controller, known as the type S drum contactor has been developed by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. It embodies practically the same principles of operation as the magnetic contactor controllers, and the originators believe it will cause great changes in present controller construction. During the past year, exhaustive tests made on these controllers have indicated that in construction they are superior to the drum and face plate controllers formerly used. They are adapted for starting and adjusting the speed of shunt, series and compound-wound direct-current motors by adjusting the resistance in series and parallel with the motor armature. They are applicable also to cranes, hoists, roll and transfer tables, and practically all applications employing this system of control.

In operation, the type S controllers employ the same principles as magnetic-contactor controllers, except that the contactors are operated by cams mounted on the controller shaft. Normal movement of the controller handle causes the contactors to open or close with a quick, positive action which reduces arcing. The arcing is further controlled by the rolling motion of the contacts, which limits all arcing and burning to the contact tips. Final contact is made with a slight wiping motion, which insures clean contact surfaces, and maximum current-carrying capacity. The line contactors, which open and close

the main line circuit, are protected by magnetic blow-outs, which aid in extinguishing any arcing that may occur.

Each contactor is closed by a hard fibre cam, operating on a practically frictionless roller on the moving contact element, and opened by a strong compression spring when the cam is moved away from the roller. This prevents the shaft from becoming locked by an accident, to a single contactor, which would otherwise prevent opening of the circuit. Each contact element is complete in itself, and can be removed as a unit.

All controllers are drilled and tapped for both a horizontal and vertical handle and can be supplied with either. The horizontal handles of controllers in service can be readily replaced with vertical handles or vice versa. The vertical type is fastened to the top of the controller by four bolts spaced equally distant from the controller



Westinghouse Type S Drum Contactor Controller

shaft and from each other. This permits it to be mounted in any one of four positions, 90 degrees apart, to facilitate placing the controller in the most convenient position, and still provide easy operation from front, back or either side. In addition, this feature enables the movement of the handle in many installations to be in the same direction as, and to be used to indicate the movement of the hoist, crane or other device. Each controller embodies all such desirable features as conduit wiring, enclosed current-carrying parts, protection against the controller being locked in running position, and prevention of accidental starting or reversing.

The new Westinghouse controller is supplied both with and without dynamic braking. Controllers for use with crane hoists regulate the speed of the motor while lowering by dynamic or regenerative braking. They are so designed that if there is not sufficient weight on the hook or cage to revolve the motor and drums, the motor will assist in the lowering. The speed of the motor is always under the accurate control of the operator, both when hoisting and lowering, regardless of the load. Cranes equipped with these controllers can have high, safe lowering speeds, if the particular motor used is capable of standing such operation.